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SPECIALISM, DEPARTMENTALISM AND PUBLIC SERVICE

IT has long been an argument against the admission of the scientific worker to administrative responsibility that the specialist is too immersed in his own particular subject to be capable of taking the wide and detached views involved in administrative decisions, and that he does not possess either the wider vision or sense of values required. Even in scientific work excessive specialization is to-day an admitted evil, and the team work necessary in the attack on many modern problems, whether in pure or in applied science, is already tending to break down such isolation and stimulate contacts between workers in different fields, to their mutual advantage.

While, however, this charge is still freely levied against the technical or scientific expert, it is strange that the analogy of this tendency with what may be termed 'departmentalism' is usually overlooked. The departmental mind, which limits its range to the efficiency or welfare of one particular department without regard to the efficiency of the whole, is one of the commonest causes of weakness in industrial firms and one of the greatest obstacles to the introduction of new ideas and new methods. Nor is the trouble confined to industry. How serious it can be in great Departments of State is well shown by Sir Arthur Salter in one of the most suggestive passages in his recent book, "Security: Can We Retrieve It?" Even the most efficient department tends to be innately conservative and unresponsive or unreceptive to new ideas, which are rarely fostered in accordance with their deserts, either in regard to staff or to finance.

This tendency is all the stronger if the specialized character of the department takes on the professional type and is reinforced by the characteristic conservatism of the professions. Only a detached administrator, possessing both knowledge, vision and judgment, as well as the requisite authority, can hope to override such professional departmentalism and prevent the prestige and ideas inherited from the past from blocking the effective development of new ideas. Nor is this indeed purely a technical or professional question. As Sir Arthur Salter points out in a further illuminating chapter on the personal equation, even in the administrator there is a grave tendency to adopt a purely defensive attitude, and to be occupied solely with the immediate need.

The question of executive administration and leadership to-day is indeed only partly a question of securing the effective utilization of technical knowledge. It is at least as much a question of finding and training men free from the departmental mind and outlook, who, while imbued with all the highest ideals of professionalism in respect of service and competency, are willing to accept responsibility, to face new issues frankly, to explore new methods, to accept criticism and to try bold measures when required. This is true of leadership and administrators alike in national affairs as in local government.

It is to the question of national leadership that Sir Arthur Salter directs attention; but the question of local government has been raised from this point of view almost simultaneously in an admirable broadsheet, "The Mechanism of Local Government", issued by P E P (Political and Economic Planning) and by G. M. Harris in his study of the practice

of local government in ten of the largest British centres ("Municipal Self-Government in Britain", by G. M. Harris. P. S. King and Sons). These two publications set forth very clearly the problems and issues involved both in the complexities of local government and the provision of councillors and officers of the requisite calibre for their service.

In local government, as in national government, there are three basic problems: the efficient development of each particular service; smooth co-ordination of different services to ensure the reconciliation of conflicting claims within each area; and the education of the citizen to create and maintain a vital and healthy community life, through both official and unofficial channels. The stress which in recent years has been laid on the efficient development of particular services has already shown that the attainment of a certain level of efficiency by arbitrary or bureaucratic methods may obstruct rather than help the general raising of standards. It may stifle personal initiative and judgment and encourage attitudes incompatible with the spread of a sense of responsibility. Local and sectional efficiency threaten at times to strengthen departmentalism and thus to hinder the development of the community as a whole.

This factor, as well as the growing complexity of central and local government, calls for councillors and administrators of the highest intellectual capacity, and above all of the constructive type who see possibilities and opportunities rather than difficulties and dangers, and who possess creative ability and the capacity to promote energetic and far-reaching projects. Technical factors in possibly half a dozen or more fields have to be assessed, and the indirect as well as the direct effects of the proposed action or policy have to be considered. Even if the administrator himself possesses the high capacity and foresight to determine the policy which will give the maximum social result or efficiency, he may still have to convince a council or cabinet of the soundness of his judgment and proposal.

Mr. Harris's inquiry into local government provides disturbing evidence that we are not getting men and women of the requisite intellectual calibre on our local or municipal councils. The increasing demands of time alone in such service deter many of the ablest industrial leaders from taking office, apart from their frequent reluctance to engage in the small politics of local elections. An analysis of the occupation of councillors will readily demonstrate the reluctance of professional men to take up such work, and the absence of intellectual leadership is accentuated by the deliberate or indirect discouragement from engaging in local or national politics given by many large organizations to their employees.

The position is in fact equally serious from the point of view of elected representatives and permanent staff. The large problem now confronting us is that of achieving further co-ordination between the efforts of public services in different areas and between the effort of all the different services operating within the same area. Such co-ordination raises many issues. Even from a purely technical or business angle, a high order of administrative capacity and advanced techniques are required to determine the most efficient units and areas of operation of many different services and for keeping their development in step according to a balanced programme to be realized over a long period of years. Even when coupled with dictatorial powers, such a task could not be performed satisfactorily without a clear grasp of principle, knowledge of the essential potentialities and limitations of different services, foresight and flexibility of outlook, and a keen eye for local conditions.

What complicates the situation is, of course, the fact that the representative bodies which control the administrative officers are at the same time expected to serve as a large-scale experiment in adult education. However firmly convinced we may be of the value of this system of responsible self-government, we cannot in the face of the demands and dangers of to-day ignore its weaknesses as exposed in practice. Ways and means must be found of delegating the discussion of administrative detail on purely technical matters on which expert advice is available, and ensuring that long-term issues and broad questions of principle receive adequate attention from the representative bodies. This means that, on one hand, some attempt must be made to give the average citizen some fuller insight into the functioning of democratic methods, their method of use and appropriate fields of application, and on the other hand to ensure that the recruitment of staff by local authorities is not limited by local resources but secures the ablest and most promising talent available.

Considerations of this kind of themselves may determine the size of areas of local government. If the unit of administration is too small or poverty-stricken, it may be impossible to staff it

with administrators and experts who are really competent to advise the local councillors. The methods of recruiting the most efficient staff and particularly the senior administrative officers become all the more important if they are to co-ordinate a number of large departments. Even if the size of an area is satisfactory and the authority has able officials and far-sighted councillors, efficiency will not be attained if the local government machine is faulty. Apart from the difficulties which inevitably arise in the co-ordination of departments, the traditional system of committee rule has aggravated the situation, and without a delicate adjustment of the machinery and co-ordination of committees, departmentalism may be further encouraged.

While, however, as the P E P broadsheet points out, the present internal machinery of local government can be criticized from the point of view of its ability to secure the working of a consistent long-term policy applicable to all spheres of the work of a council, this does not imply that the committee system is a failure. A committee may be efficient as a representative body, bringing with it local acceptance, or as an executive body carrying out or directing the administration, or more rarely as both. The danger is that in seeking to combine the two we fashion an instrument efficient for neither purpose. Unless clear thinking and vigorous leadership can secure the integration of objectives throughout local services, a co-ordinating body may in practice prove no more than another committee in a committee-ridden world.

It should, of course, be remembered that already regional developments in such fields as national defence, transport, power supply or the water catchment areas are beginning to modify both the sphere and character of local government. Some of the new bodies are appointed, not elected. While this may make for efficiency on the part of the full-time officers and draw into public service a considerable body of qualified people who would not stand for public election, these developments raise questions of some importance, whether from the point of view of efficiency or of self-government. The overlapping of functions of local authorities and independently appointed *ad hoc* bodies merits close consideration in the light of scientific management, as well for national as for local welfare.

The dangers of the present situation are indicated both by the P E P broadsheet and by Mr. Harris's book, and there can be no doubt as to the urgency of the problem. While the complexity of the problems of government increase, plans for improving its efficiency in a democratic society are much slower to develop. One factor in this is obviously the necessity for the education of public opinion as to the imperativeness of reform. Only under the pressure of enlightened public opinion can we hope to remedy effectively some of the weaknesses in our present system and stimulate the best brains and ablest administrators to take their place in the local and national council chambers. Much the same stimulus will be required to implement proposals already detailed for the more efficient utilization of the university graduate in local government, and for improved methods of recruiting and promoting staff. It is only simultaneously with the improvement in the recruitment of the permanent staff and the attraction of the best brains of the community to the council chamber that we can hope for the vision and leadership which will promote the constructive integration of services and administration so seriously needed. Meanwhile there is a wide field open for investigation into the size of administrative units, the comparative merits and value of different methods or techniques for their administration, apart from the exploration of such ideas as the staff college in reference to training and selection for the higher administrative posts in the permanent staff of industrial or local government or the civil service, and the much more difficult question of personal competence or qualification for executive responsibility in positions at present filled primarily on grounds of election and influence. Moreover, as the self-interest or profit motive in large-scale industry is replaced by a basis of service and team work, the problem of industrial management and leadership becomes closely allied to that of leadership and administration in public affairs. Here at least is an opportunity which should not be neglected by scientific workers any more than the responsibilities which they must accept as citizens for participating in the educational work required and in contributing their own share of service in the work of local and national government. Only as such opportunities are voluntarily seized can we expect that the services of the scientific or technical expert will be more wisely and effectively used, and the scientific administrator take the place in government which his administrative abilities as well as his scientific outlook both merit and demand.

JAMES GREGORY (1638-1675)

James Gregory Tercentenary Memorial Volume Containing his Correspondence with John Collins and his hitherto Unpublished Mathematical Manuscripts, together with Addresses and Essays communicated to the Royal Society of Edinburgh, July 4, 1938. Edited by Prof. Herbert Western Turnbull. (Published for the Royal Society of Edinburgh.) Pp. xii + 524 + 5 plates. (London: G. Bell and Sons, Ltd., 1939.) 25*s*. net.

THAT James Gregory was an outstanding figure in the scientific world of the seventeenth century must be generally known. The Gregorian telescope and Gregory's series are familiar evidence that he was an exceptionally gifted man. It is also known that his name, the Anglicized form of Macgregor, is that of a family distinguished in academic circles in no ordinary degree. Perhaps that celebrity owes something to the powder, wholesome but nauseous, prescribed by the great-grandson of James. At the same time it is probably less well known that in a space of two centuries this family produced a round score of men who rose to professorial or equivalent rank. But of James himself even the few who had studied his published works could have gained only an imperfect estimate. For a more adequate view it will be necessary to consult this admirable volume produced under the editorship of Prof. Turnbull for the Royal Society of Edinburgh.

The largest section of the book contains the correspondence. Of the 111 documents now printed the chief source is a collection of 57 letters at St. Andrews. These include fifty letters from Collins to Gregory. The letters from Gregory to Collins are partly reprinted from Rigaud's "Correspondence of Scientific Men" (being now inaccessible otherwise) and partly from Royal Society MSS. The other documents, less than thirty, are drawn from various sources and involve other writers. No correspondence passing directly between Gregory and Newton has been included.

Gregory's life was unhappily short. After publishing his early work, the "Optica Promota", he travelled on the Continent as far as Rome during the years 1664–1668. The greater part of the time was spent at Padua, where he imbibed the ideas of Cavalieri (d. 1647) and published two of his works, the "Vera Quadratura" and the "Geometriæ Pars Universalis". The "Exercitationes Geometricæ" is a short and remarkable tract published in London during the winter after his return. In the meantime, in the autumn of 1668, Gregory had been appointed to the professorship of mathematics newly founded by Charles II at St. Andrews. The last year of his life he spent as the first occupant of a similar chair at Edinburgh.

It was in 1663 and in London that Gregory became acquainted with Collins. John Collins was a remarkable man, with a gift for correspondence which has made him a pivot in the scientific history of the seventeenth century. He is described as an accountant; but as he was generally employed in government service, he may be regarded like Pepys as an early type of civil servant. Like Pepys he, too, was drawn into the circle of the Royal Society. His own special interest lay in the theory of equations, but the problem of quadratures appealed to him in his professional capacity and he had a wide appreciation of all the mathematical developments and writers of his time. Gregory, on the other hand, was cut off from the outer world and intellectually isolated at St. Andrews. He therefore found in Collins an invaluable correspondent and agent.

Each letter is here followed by editorial notes which give a lucid and succinct explanation of the allusions. Letters and notes together afford a mine of information on the scientific events and personalities of the day. On the tercentenary of the first observation of a transit of Venus, references to Horrocks have a topical interest. His "Opera Posthuma" appeared about August 1672, and reached Gregory the following spring, bringing the acknowledgment: "I received these letters ye mention, as also that box, together with the things contained, and particularly Horrocii Posthuma, for which I must acknowledge myself exceedingly engaged to you. I have perused him, and am satisfied with him beyond measure. It was a great loss that he died so young, many naughty fellows live till eighty." A month later Newton closes a letter to the same intermediary Collins with the laconic sentence: "I must joyn with Mr. Gregory in admiring Mr. Horrox."

These characteristic appreciations are familiar to readers of Rigaud. What is new is the account of an incident which might have led to a rupture between Gregory and Collins, and did in fact lead the latter in his agitated apology to pen a sentence which has fair claims to be considered the longest in the English language. Gregory had produced a series solution of Kepler's equation and Collins had offered to have it printed at the end of the "Opera Posthuma". Gregory assented, but the addition was not made. Taxed with the omission, Collins explains very late in the day

that "Hickman a Bookseller the undertaker broke" and the printer refused to throw good money after bad by making any addition. Prof. Turnbull blames Collins for not keeping Gregory informed of these circumstances. Possibly also Collins may have exceeded his authority in making the original suggestion, since Wallis, not Collins, was the editor of the work. In any case the piece had only a mathematical interest, and though it must be deplored that it was not published, a book consecrated to Horrocks was not the place for it.

But valuable and interesting as the correspondence will be found, illuminated as it is by editorial comments, the book owes its most important feature to another circumstance. Gregory was a careful man and he used the blank spaces of the letters he received to record his own mathematical notes. With patient industry and no little ingenuity Prof. Turnbull has reconstructed these notes, and the result reveals the remarkable progress made by Gregory in attacking the mathematical problems of his day. Though this work was, with slight exceptions, never published, it must be taken into account in arriving at any estimate of Gregory's powers.

The notes touch on a variety of subjects. Not the least interesting are those which deal with the theory of numbers and show that Gregory, like Wallis, had entered seriously into a field in which it has commonly been supposed that Fermat reigned supreme and alone. But in view of their date, it is naturally the notes which deal with the calculus which possess the most general interest.

Since the days of the "Commercium Epistolicum" the dispute over priority between Newton and Leibniz has lost its edge. If the question is asked: Who was the inventor of the calculus, the preliminary question arises, what is meant by "the calculus"? If the answer is made to depend, as it reasonably can be, on the notation which is now associated with the operations of the calculus, the inventor was Leibniz, and about that there has never been any dispute. If the question refers to the general ideas and principles of the calculus, the invention can scarcely be attributed to one of two men, for it was the work of a generation of which the history has certainly not been fully explored yet. As to the subject, the problem of quadratures was old enough, and isolated solutions had been found as early as the Greeks. Similarly the calculation of rates of change (fluxions) could present no great difficulty when the need arose. Hence the critical step is to be seen in recognizing the inverse relation between these two processes. Now this relation was first pointed out, if in only a geometrical and limited form, by Gregory in his "Geometria pars universalis" (1668), two years before Barrow published the same result.

It is therefore of peculiar interest to follow the evolution of Gregory's ideas as Prof. Turnbull has reconstructed them. At the time, the knowledge of geometry was far in advance of what Gregory calls "analyticks" He himself was well equipped for the task of promoting this side of mathematics. In his "Vera Quadratura", where convergent sequences are explicitly introduced, he had shown an exceptional sense of the nature of infinite processes. The resulting conflict with Huygens was most unfortunate, for Huygens was essentially a fair-minded and generous man, as he showed afterwards when he recommended Gregory for a position in the Paris Academy. It was from the geometrical side that Gregory approached the subject, and indeed by calculating the subtangents of curves ($y.\,dx/dy$). Only later he recognized the primary significance of the derivative, and from this point he was quickly led to the process of successive differentiation. Armed with this weapon, he used his results to calculate power series and thus anticipated Taylor's theorem by nearly half a century. It has always seemed strange that this discovery was reserved for Brook Taylor; perhaps Colin Maclaurin appears a more natural heir to his own part of the legacy. But Prof. Turnbull has now shown that Gregory was in effective possession of the secret. By his failure to publish the method not only has Gregory lost his due recognition, but also, what is more important, the progress of mathematics must have been retarded at the time. As it is, while applications of the method by him have been established, there is no trace of a general proof. It is also to be noticed that there is no sign of any attempt to devise or employ an appropriate notation. Apparently Gregory felt no need for one. He was working for his own satisfaction.

Gregory's short life closed in 1675. The date and the shortness of the span combine to make what he accomplished remarkable. The more important formulæ of interpolation were his discovery. So was the general binomial theorem, under the guise of finding "the number of a logarithm". A set of excellent essays on the published works of Gregory completes the work, and suggests that a valuable source of information has been too little regarded. But the feature which distinguishes this from the generality of memorial volumes is the reconstruction of Gregory's fragmentary original notes. Under Prof. Turnbull's expert guidance it is possible to look over the mathematician's shoulder and see him actually at work. For this reason the book is not only a valuable contribution to the history of mathematics: those who are interested in the subject cannot fail to find it as fascinating as it is instructive.

H. C. PLUMMER.

CHEMISTRY OF THE ALKALI AND ALKALINE EARTH METALS

Gmelins Handbuch der anorganischen Chemie Achte völlig neu bearbeitete Auflage. Herausgegeben von der Deutschen Chemischen Gesellschaft.

(1) System-Nummer 22: Kalium. Lief 4: Verbindungen bis Kaliumacetat. Pp. 805–932+xxv. 15 gold marks.

(2) System-Nummer 22: Kalium. Lief 5: Verbindung bis Kalium und Wismut. Pp. 933–1074. 19.50 gold marks.

(3) System-Nummer 24: Rubidium. Pp. xviii+x+250. 31.50 gold marks.

(4) System-Nummer 25: Caesium. Lief. 1: Verkommen, Darstellung und Eigenschaften des Metalls. Pp. 104. 12 gold marks.

(5) System-Nummer 25: Caesium, mit einem Anhang über Ekacaesium. Lief. 2: Verbindungen des Caesiums, Ekacaesium. Pp. xx+105–268+ix. 21.75 gold marks.

(6) System-Nummer 27: Magnesium. Teil B, Lief. 1: Verbindungen bis Magnesium und Jod. Pp. vii+200. 23.25 gold marks.

(7) System-Nummer 27: Magnesium. Teil B, Lief. 2: Verbindungen bis Magnesiumcarbonat. Pp. 201–330. 15.75 gold marks.

(8) System-Nummer 27: Magnesium. Teil B, Lief. 3: Verbindungen bis Magnesium und Wismut. Pp. 331–422+xiv. 12 gold marks. (Berlin: Verlag Chemie, G.m.b.H., 1937–38.)

(1, 2) SECTIONS 4 and 5 of the volume on potassium of this great work deal with its compounds with boron, silicon, phosphorus, arsenic, antimony and bismuth. Three derivatives of the boranes have been identified, namely, $K_2B_2H_6$, $K_2B_4H_{10}$ and $K_2B_5H_9$, of which the first is the most stable. Stock and his collaborators have shown that although boroethane acts as a dibasic acid, it is also unsaturated, so that when potassium acts upon it the ionized hydrogen is not discharged but is used to saturate the boron complex, its charge being transferred to the metal: $H_2(BH_2:BH_2) + 2K = K_2(BH_2.BH_2)$. On hydrolysis of the product, a dihydroxydiborane $K_2[H_4B_2(OH)_2]$ is formed, which was formerly regarded as a hypoborate, KH_2BO. Further hydrolysis yields potassium metaborate. The existence of five anhydrous and three hydrated potassium borates is indicated on the phase-rule diagrams, but only one borofluoride is mentioned.

In dealing with the manufacture of potassium carbonate, although many different methods are given, chief stress is laid upon the Engel-Precht process from sylvine and magnesium carbonate and the electrolytic process. The manufacture of potassium cyanide is dealt with fully and some organic salts are also described. Varying results seem to have been obtained for the solubility of potassium bitartrate according to the method chosen.

The constitution of the metaphosphates of potassium is not yet completely established. Only polymeric forms appear to exist, namely, tri-, tetra- and hexametaphosphates. The hexametaphosphate is obtained as a hygroscopic mass by precipitating the lead salt and allowing it to react with potassium sulphate. On heating this to 660° C. the insoluble Kurrol salt is formed. There is also some uncertainty as to the actual constitution of the antimonate and of tartar emetic, for the latter of which three possible structures are suggested.

(3, 4) The heavy alkali metals rubidium and cæsium are both obtained from artificial carnallite, a by-product in the extraction of potassium from the mineral, which contains 0·02 per cent of rubidium chloride and only 0·0002 per cent of cæsium chloride. By the action of water much of the potassium chloride can be crystallized out, when both rubidium and cæsium may be precipitated from the concentrated mother-liquor as silicomolybdates. The molybdenum is then removed by volatilization as oxychloride in a current of hydrogen chloride. From an acid solution of the residue, potassium and rubidium free from cæsium can be precipitated as chlorides by addition of alcohol, and antimony chloride will precipitate cæsium antimony chloride free from the other alkali metals. The rubidium is freed from potassium by repetition of the silicomolybdate process. It is obtained pure by the electrolysis of the fused hydroxide. Iron wire surrounded by magnesite is used as cathode and two diaphragms are needed to protect the metal from anodic oxidation.

Cæsium is obtained chiefly from the mineral pollucite, a cæsium aluminium silicate found in the felspar quarries in the State of Maine, U.S.A. It can be obtained pure from its cyanide by electrolysis, and on account of its low melting point (28·6° C.) it can be filtered under petroleum. The metal is used in the construction of photocells and thermionic valves. Very thin layers of cæsium on a metallic surface give a much stronger photo-electric effect than compact layers, but the

action is rather complex. Up to a certain minute thickness, while the cæsium is held solely in the form of *ions* on the surface it produces no selective effect, the photo-emission proceeding entirely from the under layer of metal. Beyond that point *atoms* of cæsium begin to be adsorbed which can themselves emit photo-electrons, but when the layer is about one atom in thickness reversal of the dipoles occurs with a consequent shift of the photo-chemical threshold towards shorter wave-lengths.

Rubidium chloride and bromide become coloured under the influence of radium or X-rays, and rubidium tri-iodide, unlike potassium tri-iodide, can be obtained in the anhydrous form. The rubidium salts of the tartaric acids show reversal of sign in optical rotation for sodium light.

(5) Compounds of cæsium, though similar to those of other alkali metals, exhibit certain peculiarities. Thus we find no fewer than four sub-oxides in addition to the basic monoxide and the two peroxides, and although the fluoride crystallizes like sodium chloride and other alkaline halides in face-centred cubes, the chloride, bromide and iodide of cæsium assume the body-centred cubic lattice. Of the last three compounds the chloride alone is dimorphous, its crystal form changing at about 445° C. to the face-centred type. Again, various polyhalides such as $CsBr_3$, CsI_3, CsIBrCl, etc., have been isolated in stable unsolvated form. The cæsium analogue of tartar-emetic has been prepared and like the latter is now formulated as a co-ordinated aquo-salt $Cs[Sb(C_4H_4O_6).H_2O].\frac{1}{2}H_2O$.

Many attempts have been made to isolate element No. 87, Mendeléeff's eka-cæsium, but so far the evidence of its existence rests on a somewhat slender basis. If the element exists at all, it appears to be extraordinarily scarce. In 1929 Papish and Wainer obtained several alums from the alkalis extracted from samarskite, a mineral rich in uranium, and after repeated recrystallizations the fraction richest in cæsium and poorest in potassium was found to give five of the X-ray spectral lines calculated for eka-cæsium by Moseley's rule. Examination by the mass-spectrograph of this alum indicated the existence of ions of mass 220 ± 1 at 600–700° C., but their intensity was about 10^{-4} of that of the cæsium ions.

(6, 7) Compounds of magnesium with most of the non-metals are described in Parts B 1 and 2. At present only spectrographic evidence is available of the existence of a hydride. The oxide is very stable and is not reduced by hydrogen at 2,500° C. under a pressure of 150 atmospheres. The dioxide has not been obtained in the pure state, but by the action of hydrogen peroxide on salts a product rich in oxygen has been obtained which gives a stable compound, $MgO_2.3MgO.Aq$, on exposure to air. In addition to the well-known nitride, magnesium yields an explosive azide MgN_6, a diamide, a hexammine and many co-ordination compounds with organic bases.

The hydrolysis of magnesium chloride by water vapour occurs in two stages, the formation of basic salt being exothermic, whereas above 505° C. an endothermic decomposition to oxide occurs. On the other hand, the salt is not hydrolysed by liquid water even under pressure, although the solution has a strong corrosive action on metals and alloys. At room temperature, pyrites is oxidized in presence of a solution of magnesium chloride to ferrous sulphate and sulphuric acid. Magnesium chlorate and its tri-hydrate are very powerful dehydrating agents, the anhydrous salt being twice as effective as the hydrate. Both can be used with advantage for drying gases; and since they are neutral in reaction, have a greater capacity for absorbing water than phosphoric anhydride, do not become pasty on exposure to air and can be regenerated after use, they may be regarded as superior to other dehydrating agents. The tri-hydrate can absorb about 20 per cent of its weight of water to form the hexahydrate. As it yields a hexammine, it is not suitable for drying ammonia.

Magnesium sulphide can be obtained in an exceptionally pure state by the action of carbon disulphide on magnesium sulphate in a current of nitrogen at 700–900° C. It is not luminescent unless it contains traces of other metals with smaller atomic diameters than magnesium. The colour of the phosphorescence depends on the foreign metal.

Several hydrates of the sulphate are known; the anhydrous salt is not obtainable from a solution in water, but can be prepared by careful dehydration of the heptahydrate, although hydrolysis is apt to occur during the process. The dehydration of magnesium carbonate tri-hydrate is generally accompanied by loss of carbon dioxide unless the experiment is carried out in a closed vessel, when the basic salt which is first formed slowly re-absorbs the gas to form the anhydrous salt. The precipitation of *magnesia alba* is a rather complex process. When the proportion of sodium carbonate to magnesium sulphate in solution is insufficient to cause precipitation, magnesium carbonate trihydrate can be crystallized out, whereas excess of the alkali will precipitate a basic salt. A table is given showing the composition of the mother-liquor resulting under various conditions.

(8) In this part will be found accounts of salts of magnesium with a few of the commoner organic acids, together with compounds containing silicon, phosphorus, arsenic, antimony and bismuth.

Naturally occurring silicates of the metal are dealt with elsewhere, although the phase-rule diagram of the system $MgO : SiO_2$ is given and also full details of the physical properties of the anhydrous orthosilicate and the varieties of metasilicate, namely, clino-enstatite, enstatite, and the monoclinic and rhombic amphiboles. The phosphates present some rather formidable structural problems on account of their number and variety.

It would be interesting to discover the orientation of the stable salt $Mg_3(PO_4)_2.22H_2O$, which Bassett and Bedwell observed to change to the octahydrate, in presence of the mother-liquor, in the course of a few weeks. The work of these authorities on the glowing of orthophosphates and pyrophosphates might have been given in fuller detail, particularly their observations on the heat evolution on glowing and their co-ordination theory of the structural changes which accompany the glow. A structural formula has recently been assigned by Beintema from X-ray analysis to magnesium antimonate $MgO.Sb_2O_5.12H_2O$, in which six molecules of water are co-ordinated with the cation and six hydroxyl groups with each of two anions, thus: $[Mg(H_2O)_6]\,[Sb(OH)_6]_2$.

CLIMATE AND MAN

Klima, Wetter, Mensch

Von E. Brezina, W. Hellpach, R. Hesse, E. Martini, B. de Rudder, A. Schittenhelm, A. Seybold, L. Weickmann. Herausgegeben von Heinz Woltereck. Pp. viii + 446. (Leipzig: Quelle und Meyer, 1938.) 18 gold marks.

THE subject of this book is climate and weather as part of man's environment—*Lebensraum* in the literal sense—including not only the natural air of the free countryside, but also the modified air of great cities, houses, air-conditioned buildings and, on a still smaller scale, within clothing. These studies on the borderlands of meteorology and biology or medicine are highly specialized, and they are dealt with in a series of memoirs by different authorities. In the first and longest section, Prof. L. Weickmann sets out the fundamental basis, the elements of climate and weather. This is to some extent orthodox meteorology, but with a difference. It starts with a detailed account of solar radiations of all wave-lengths and their biological effects; other climatic elements in turn are treated from the same point of view. 'Sensible' temperature and the cooling power of air are fully discussed, while for humidity the important quantity is taken as the physiological saturation deficit.

The processes of weather come next; here the biological aspect is to some extent lost sight of, and the author is drawn aside into his favourite topic of rhythms in barometric pressure. This is followed by an account of seasonal and other long-period weather changes, and the section ends with a thorough and interesting account of the modern study of micro-climatology, the effect of small surface features—hills and valleys, streets, forests and growing crops. These minute studies have been pursued very thoroughly in Germany in recent years, and the book contains a great deal of information which is not otherwise readily available, as well as some striking illustrations.

In the rest of the book the emphasis is mainly on the biological aspect. B. de Rudder has an important memoir on the basis of human bioclimatics, divided into the influence of the separate climatic elements, of climate in general and of weather (meteorobiology). Solar radiation still holds pride of place, from such diverse aspects as rickets, sunburn, and the coincidence between outbreaks of cerebro-spinal meningitis and sun-spot maxima. In questions of bioclimatics there are still plenty of unknown quantities. A. Schittenhelm deals with the curative factors of different types of climate, stressing the need for medical advice in selecting the correct treatment, for example, for nervous diseases. E. Martini describes the part played by climate in the causation of disease—a highly complex subject involving the life-history of the organisms responsible for epidemics such as malaria, which is treated at length. The remaining chapters, comparatively short, are: Man in an Artificial Climate (E. Brezina); Plants, Climate and Weather (A. Seybold); The Animal and the Climate (R. Hesse); and Culture and Climate, by W. Hellpach, a philosophical essay on 'culture', relating not only material civilization but also political development, religion and other spiritual values to the natural environment, of which climate is an important part.

The book is well printed, but in the Gothic type which he who runs (or travels by train) finds difficult to read. There are no exact references, merely citations of a few names; there is no bibliography and no author index, so that it is very difficult to follow up or find the authority for any particular statement.

C. E. P. BROOKS

A SYNOPSIS OF GENETICS

An Introduction to Genetics

By Prof. A. H. Sturtevant and Prof. G. W. Beadle. Pp. 391. (Philadelphia and London: W. B. Saunders Co., Ltd., 1939.) 14s. net.

THE increasing number of publications of recent years which deal with the subject of inheritance is testimony to the keen interest in the laws and principles of this science. Our knowledge of it increases daily through the research activities of universities, experiment stations and other institutions, and it is becoming exceedingly important now to disseminate this knowledge in order to make further progress possible. Genetics is taught in the universities of the United States as an important subject in biology, and in Great Britain, where the teaching of biology is still backward, genetics has been given the place of a Cinderella. A few years ago it was perhaps sufficient to acquaint the student only with Mendelian ratios; nowadays, however, the rapid advancement of genetical discoveries makes it necessary to study in greater detail the intricate mechanism by which characters are transmitted.

At present there are several introductory textbooks. All have some defects due chiefly to oversimplification, omissions, or lengthy discussions of insignificant details, which prevent these textbooks from satisfying in all respects the needs of teachers and students of genetics. The book under review is written by two well-known authors, and it is planned as an introduction to genetics for the use of students with an elementary knowledge of biology. The senior author is one of those pioneers who are responsible for the foundation of modern genetics; to him we owe much of our concept of the linear arrangement of genes in the chromosomes and the construction of the first chromosome map. Dr. Beadle's researches on maize genetics are widely recognized, and his recent contributions in collaboration with Dr. B. Ephrussi have opened up a new approach to the study of the developmental properties of the hereditary material. Obviously, a book written by such eminent authors should be judged by a high standard.

The order in which the material is presented is claimed to be a natural one and the reader will find the approach to genetics entirely novel. The opening chapter deals with the inheritance of sex, sex being the most widely spread and generally recognized discontinuous character and the mechanism underlying its inheritance the most simple and easily understandable. The other chapters follow in logical sequence, though it is difficult to explain why Chapter xv, inheritance in trisomics and tetrasomics, is separated from that on polyploidy (Chapter xix) by discussions on sex determination, population genetics and selection. An encyclopædic tendency is often revealed by bringing together apparently unrelated phenomena; for example, Chapter xvii, which deals with multiple genes, also includes a discussion on asexual reproduction and identical twins.

Throughout the book emphasis is laid on the mechanical aspect of heredity. Mendelian laws and probability expectations are presented in a way that will soon convince the student that genetics is a 'mathematically developed subject'. Nothing has been omitted which will help to elucidate to the student the method of character transmission. The authors direct special attention to crossing-over, a process responsible for new combinations of characters. It is the first textbook of genetics in which the consequences of crossing-over are presented correctly; crossing-over is described as an event which takes place during the meiotic prophase when the associated homologous chromosomes are in the four-strand stage, and its products are interpreted in this sense throughout the whole book. To illustrate the various characteristics of the process of crossing-over, the behaviour of attached-X chromosomes in Drosophila is presented at great length. One may wonder, however, why the authors failed to direct attention to the effects of age, sex and temperature upon crossing-over, since these are of practical importance. Teachers and students will regret that the various topics are discussed too briefly, for while in this way the student can get a clear idea of the principles involved, he will need a teacher's assistance to understand all the essentials. This difficulty will become obvious in working out the problems, for in many cases the student will not be able to solve these very interesting and instructive problems unless he makes use of the references quoted at the ends of the chapters.

The authors, wishing to appear impartial and objective, confine themselves to a strict presentation of facts. Certain data are recorded without any interpretations whereas others are completely omitted, presumably because the authors do not consider them proved experimentally. This alone is probably the reason for omitting an account of Haldane's interesting method and results relating to partial sex-linkage and the first chromosome map in man. No reference is made to Fisher's theory of dominance, which as a scientific thought

is worthy of report. As an example of where caution can be excessive, we should like to direct attention to a statement (p. 301) that new shoots which develop from the callus tissue in decapitated tomato seedlings "for some unknown reason" are frequently tetraploid. It would appear entirely reasonable—and it is moreover supported by Mather's observation (*J. Genet.*, **27**, 127; 1933)—that somatic doubling of chromosomes may have resulted from failure of wall formation in the dividing cell, followed by a fusion of the two nuclei during the next resting stage or division. May not such extreme caution in avoiding references to plausible suggestions defeat the very purpose of the book, namely to stimulate thought and inspire inquiring reasoning in the student?

However, these few criticisms cannot belittle the great value of the book. The most striking impression which the reader gets is of the great wealth of information which has been condensed into the twenty-three chapters it contains. Much of this has been gained by the personal experience of the authors. Various genetical phenomena, especially those which have been experimentally tested, for example, homozygosis, attached-*X* chromosomes, ring chromosomes, somatic crossing-over, preferential segregation and others too numerous to mention, which are either omitted or only briefly dealt with in other text-books, are here described and explained in detail. The diagrams are particularly excellent and instructive. It is evident that the authors' interests are centred in Drosophila and maize genetics, most of the examples given to illustrate the working mechanism of heredity being taken from these fields—perhaps more than are necessary. The novelty of presentation and inclusion of fresh material render this book a particularly important contribution to genetical literature, and its value will be fully appreciated only when it has been in use. The book is comprehensive, up-to-date and reliable, and the information which it contains is accurate—thus it can claim to be more than a text-book; it will be regarded by many a teacher and student as a veritable encyclopædia of genetics.

P. C. KOLLER.

RADIO-COMMUNICATION

(1) The Elements of Radio-Communication
By O. F. Brown and E. L. Gardiner. Second edition. Pp. viii + 551. (London: Oxford University Press, 1939.) 16*s*. net.

(2) Télégraphie et téléphonie sans fil
Par C. Gutton. (Collection Armand Colin: Section de physique, No. 6.) Neuvième édition entièrement refondue. Pp. 183. (Paris: Armand Colin, 1939.) 15 francs.

(3) The Radio Manual
For Radio Engineers, Inspectors, Students, Operators and Radio Fans. By George E. Sterling. Third edition. Pp. vi + 1120. (London: Chapman and Hall, Ltd., 1938.) 25*s*. net.

THE science and practice of radio-communication have, during recent years, advanced at such a rate that it is desirable that the books dealing with fundamental principles should be revised to keep abreast of the progress, and also that new books or monographs should deal in an up-to-date manner with the latest phases or applications of the subject.

(1) The first book under consideration here was produced by the first-named author about twelve years ago, and a second edition has now been prepared in co-operation with the second author. This work gives a comprehensive survey of the elementary principles underlying radio-communication and is suitable either for the general reader or for the student making an early acquaintance with the subject. Although it is almost entirely devoid of mathematics and formulæ, the treatment of the whole subject is on a very sound and easily understood basis. This second edition covers the whole subject from the generation and study of high-frequency oscillations to their application in the various forms of radio-communication, including telegraphy, telephony, broadcasting and television.

In covering this wide field, the authors have very wisely avoided giving any detailed attention to those specialized sections of the subject which are adequately treated in other works, to which the serious student may refer. They rightly suggest that this work forms a useful elementary text-book on the subject, and with the view of enhancing its utility in this respect, a number of questions have been appended to each chapter, the majority of these questions having been extracted from the examination papers of various technical institutions granting certificates to successful candidates.

The general production of the book is very good; misprints are rare, but it would have been an advantage if more of the chapters had been sectionalized and provided with sub-headings.

(2) Although the second book under notice is

described as the ninth edition, it is explained in the preface that the text has now practically been rewritten in order to produce a comprehensive survey of the principles of radio-communication in the light of modern knowledge and practice. The subject is treated in a general but not too elementary manner, it being assumed that the reader has some slight acquaintance with electrical circuits and alternating currents. The volume is of a very handy pocket size and should be appreciated by those who desire a general survey of the subject in the French language.

(3) The sub-title of the third book indicates the class of reader for whom it has been especially prepared, namely, those engaged in the production, operation, inspection or maintenance of radio-communication apparatus of all types. The first edition of the work was published in the United States some ten years ago, and it has undoubtedly been a success in its right sphere. The present edition of more than a thousand pages is a working manual of the practice of radio-communication on land, at sea, and in the air, with illustrated descriptions of the equipment used, and including detailed explanations of the general regulations and operating procedure appertaining thereto.

So far as the publication of the book in Great Britain is concerned, its usefulness is severely limited by the fact that the majority of the systems, apparatus and regulations described are representative of American practice, and so they are not of general direct interest to those engaged in radio-communication outside the United States.

R. L. S.-R.

STEAM DATA

(1) Abridged Callendar Steam Tables

By the late H. L. Callendar, revised by G. S. Callendar. Fourth edition. Centigrade Units. Pp. 8. 1*s*. net. Fahrenheit Units. Pp. 8. 1*s*. net. Charts for above. 18½ in. × 16 in. 6*d*. net each. (London: Edward Arnold and Co., 1939.)

(2) The 1939 Heat-Entropy Diagram for Steam Plotted from the 1939 Callendar Steam Tables

Based on Research by Prof. A. C. Egerton and G. S. Callendar. (Published for the British Electrical and Allied Industries Research Association.) 38½ in. × 33½ in. (London: Edward Arnold and Co., 1939.) 4*s*. net.

(1) IN association with the 1939 Callendar Steam Tables [Fahrenheit Units] there have also been published, in convenient octavo pamphlet form, two sets of Abridged Callendar Steam Tables. These, which are now in their fourth editions, are available both in centigrade units and in Fahrenheit units, and appropriate to each there has also been prepared a total heat-entropy chart, 15 in. × 18 in.

In these tables and charts a considerable amount of revision has been effected in order to bring the figures presented into accord with the results of recent work in this field of research. To meet also the extending needs of those concerned with the design, testing and operation of steam plants, the values have been carried on to a pressure of 3,000 pounds per square inch. Included are a number of equations for saturated steam and general equations for steady flow, so that for most general purposes these publications supply such information as will be required at very moderate cost—a consideration which should place them within the reach of students.

(2) Where, however, the nature of the work demands more extensive data and a chart of larger scale, the 1939 Heat-Entropy Diagram for Steam is now available. This is of large size, on a sheet 38½ in. × 33½ in., and has been plotted from the 1939 Callendar Steam Tables based on research by Prof. A. C. Egerton and Mr. G. S. Callendar, on behalf of the British Electrical and Allied Industries Research Association. It has been produced in three colours and, as a result, any one of its closely grouped series of lines can be followed with ease to the desired point or vice versa. The lattice on which the diagram is plotted and which represents co-ordinates of entropy and heat is shown in green, the scales being 1 cm. to 0·01Φ and 1 cm. to 10 B.Th.U. per pound. The pressure, temperature and dryness curves are in black, while those of volume and superheat appear in red. Recalling the trend of these several curves in this type of chart, it will readily be seen that the arrangement adopted is the most favourable to ease of interpretation.

The care which has been taken in plotting the vast number of values which have been necessary for the preparation of so extensive a diagram, and the remarkable accuracy with which it has been reproduced in three different colours, reflect the highest credit on those responsible for the original and on those also to whose technical skill its reproduction is due.

TISSUE RESPIRATION

BY PROF. R. A. PETERS, F.R.S.,
DEPARTMENT OF BIOCHEMISTRY, OXFORD

A DISCUSSION on tissue respiration was organized for August 31 jointly between Sections B and I (Chemistry and Physiology) of the British Association at Dundee. Owing to the imminence of war several of the proposed speakers were unable to attend, namely, the organizer and opener Prof. R. A. Peters, Dr. Malcolm Dixon, Prof. H. Theorell, Dr. D. E. Green and Dr. T. Mann. Prof. D. Keilin also did not attend. Prof. H. S. Raper, who was intending in any event to give a contribution towards the end of the discussion, kindly offered to introduce the subject and ably substituted for the absent speakers, so that the comparatively large attendance was not in vain. In order to give a more comprehensive survey of the subject, it has been thought advisable to follow in this account the lines of the addresses as originally planned.

To make a coherent account of tissue respiration for the benefit of those unfamiliar with it, the subject was divided into the parts concerned with the organized tissue cell and those relating to the isolated tissue component. Starting with the present position of knowledge of the isolated components, the discussion worked through to the respiration of the more highly organized tissue slice, and ultimately to the chemical control of the whole system.

The address of the opener was intended to deal briefly with the historical background, pointing out that the subject had roots in the distant past, but had developed rapidly only in the most recent years. In a short time it was clearly impossible to do justice to the work of the pioneers; but the following must be especially mentioned: the importance of Wieland's theories of hydrogen activation, of Hopkins' isolation of glutathione, of Thunberg's methylene blue technique, of Keilin's cytochrome, and of the various contributions from Warburg and his co-workers and from the Stockholm school under von Euler. Much advance in knowledge had come from the use of the *in vitro* study; to allay any doubts as to the value of the isolated tissue preparation, it must be emphasized that in studies at Oxford there has been found to be a remarkable parallelism between the improvement of respiration in the avitaminous pigeon's brain by the addition of vitamin B_1 *in vitro*, and the similar action of the latter in curing symptoms of deficiency *in vivo*. Such studies form a valuable bridge for the interpretation of *in vivo* happenings by the use of *in vitro* preparations. Owing to the short time available, some important aspects of the subject had to be pruned, among them being glutathione, vitamin C, oxidation-reduction potential in relation to tissue respiration processes, adequate discussion of the Szent-Györgyi catalytic system of C_4 acids, also the plant oxidase reactions, which, though not strictly tissue respiration in the animal in this sense, have been so valuable a feature of contributions from the laboratory of Prof. Raper.

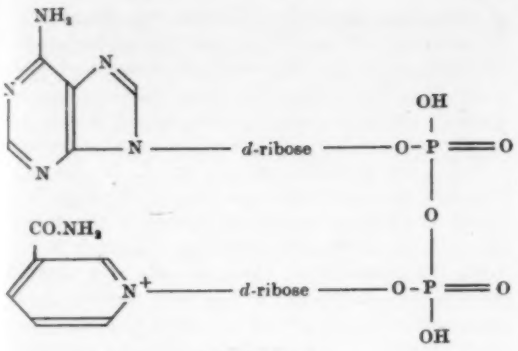
Dr. Malcolm Dixon's introductory address (Cambridge) dealt with the general subject "Catalysis in Respiration". Defining tissue respiration as the utilization of molecular oxygen for the oxidation of organic substances in tissues, Dr. Dixon stressed the fact that tissue respiration is essentially a problem of catalysis, and dealt with the questions: How do the catalysts work? What is their chemical nature? And how do they co-operate in respiration? Owing to recent work, the main features of this mechanism are now fairly clear. We have the two types of respiratory catalysts, the *activators* and the *carriers* respectively. "The *activators* are enzymes, very highly specific in many cases, which combine in a loose but highly specific way with their substrates, so that the combined substrate is reactive". The *carriers* work differently; though mostly not enzymes, they enable two compounds which we may designate AH_2 and B, incapable of reacting with one another directly, to react through their agency along the lines of equations 1 and 2:

$$AH_2 + C = A + CH_2 \quad (1)$$

$$CH_2 + B = C + BH_2, \quad (2)$$

in which 2H is so transferred from A to B. Since the organic 'substrates of respiration' are oxidized in an ordered series of successive reactions (steps of 2H at a time), a large number of activating catalysts is involved; about twenty-five distinct dehydrogenases (enzymes concerned in H transfer) are known. There is the further complication that activated substrates require further carriers to bring them into relation with molecular oxygen. As an example,

(1) (2) (3) (4) (5)
Triosephosphate → CoZ → FP → Cytochrome → O_2 (3)
(Triosephosphate D) (Cytochrome oxidase)
FP = Flavoprotein D = dehydrogenase



COZYMASE

Fig. 1

In such a scheme H is transferred in the direction of the arrows. The carrier cozymase (CoZ) (Fig. 1) is very important. It is a compound of adenylic acid and nicotinic amide-ribose-phosphate, in which the essential group is the nicotinic amide; one double bond of this is capable of reversible reduction. The cozymase like the triosephosphate combines loosely with the dehydrogenase; the enzyme then catalyses the bimolecular reaction which results in the oxidation of the triosephosphate and reduction of the cozymase. The latter then combines loosely with the flavoprotein and becomes re-oxidized. In its turn the reduced flavoprotein reduces Keilin's cytochrome *C*, a specialized hæmochromogen, the latter being oxidized by oxygen in presence of the enzyme cytochrome oxidase. This means that the real function of respired oxygen is to keep the tissue cytochrome in an oxidized state; and that the oxidations of tissue constituents are really a succession of H transfers from them to the oxidized cytochrome, sometimes interpolated with reactions involving the addition of the elements of water.*

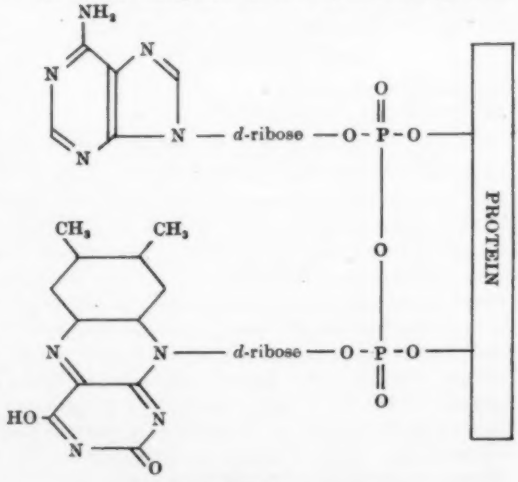
It is important to realize that these enzymes are quite general for both yeast and animal tissues. Parts 2, 3, 4 and 5 of equation 3 are common for the oxidation of many different substances; only the dehydrogenases are different; the reactions in which cozymase plays a part are reversible and in the absence of oxygen the dehydrogenase systems may react with one another through cozymase, producing fermentations. Dr. Dixon concluded by reference to known variations upon the main theme. In some cases there is a substitution of coenzyme II (triphosphopyridine nucleotide) for cozymase; there exists a small group of dehydrogenases which react direct with cytochrome; Szent-Györgyi has produced evidence that in total respiration a definite part is played by the C_4 dicarboxylic acids (fumaric, etc.) which bring about the oxidation of reduced cozymase by cytochrome in an indirect way. Dixon further pointed out that most links in the chain can be represented artificially with other substitutes such as dyes. The use of methylene blue instead of molecular oxygen plus the cytochrome system is the basis of the well-known Thunberg method of investigating dehydrogenases.

Dr. Dixon's succinct but comprehensive paper was to be followed by Dr. Theorell (Sweden), dealing with the developments in our knowledge of the flavoproteins (Fig. 2). These are compounds of proteins with the component of the vitamin B_2 complex, which is known as riboflavin, di-methyl-alloxazine-ribose-phosphate. The old yellow ferment of Warburg and Christian, which was finally obtained in quite pure condition by Theorell himself, and which consisted only of riboflavin-protein, is probably an artefact. In its place now six new flavoproteins have been described. All of these have as their prosthetic group riboflavin and adenylic acid, called after Warburg alloxazine-adenine-dinucleotide; the protein component differs.

FLAVOPROTEINS

No.	Transfers H between		Workers	Source
1.	O_2; di-H_2-pyridine		Warburg and Christian	Yeast
2.	O_2; amino-acids	Krebs' d-amino-acid oxidase	Das, Straub, Warburg and Christian	Kidney
3.	Meth. blue; di-H_2-pyridine		Haas	Yeast
4.	O_2; xanthine	Xanthine oxidase	Ball, Green	Milk
5.	Cytochrome; di-H_2-pyridine		Corran and Green	Milk
6.	Cytochrome; di-H_2-pyridine	Diaphorase	Green, von Euler, Straub	Heart muscle

With the exception of No. 1, all have protein



FLAVOPROTEIN (STRAUB)

Fig. 2

* Such a view of the function of respiratory oxygen is revolutionary as compared with views of, say, ten years ago.

components different from the original Warburg and Christian 'yellow ferment'.

The contribution given by Dr. F. Dickens (Newcastle) formed the first bridge between the properties of the isolated systems and those systems organized in the tissue cells themselves. Directing attention to the tissue slice technique of Warburg for studying respiration, he considered that this proved in practice a fruitful compromise between the intact and macerated state, though minced tissue 'brei' where cell boundaries were destroyed was valuable for substances to which intact cells were impermeable. Tissue slices must be of appropriate thickness to allow of proper gas and substrate exchange. Under good conditions, slices of tissue in glucose solutions (Ringer bicarbonate or phosphate) will maintain remarkably constant rates of respiration, whereas with succinate as substrate this is not so; useful information as to the type of substance undergoing change can also be obtained by an estimation of the respiratory quotient, CO_2/O_2, as also by employing poisons which inhibit certain parts of the respiratory system. Dr. Dickens pointed out in a striking way the essential difference between the views of Szent-Györgyi and Krebs and Johnson as to the effect of the C_4 dicarboxylic acids. In the former case, catalysis is considered to be due to a series of reversible reactions, whereas in the latter the reactions proceed only in *one* direction, citric acid being supposed to form part of the reaction chain. In a discussion of this, Dr. H. A. Krebs (Sheffield) considered the dismutation of keto acids in bacteria and animal tissue, along the lines indicated by the following equations.

Anaerobic:

$$2COOH.CH_2CH_2.CO.COOH + NH_3 = COOH.CH_2CH_2CHNH_2.COOH + COOH.CH_2CH.COOH + CO_2 \quad (4)$$

Aerobic (with O_2 present):

$$COOH.CH_2CH_2.CHNH_2.COOH + O \rightarrow COOH.CH_2CH_2.CO_2.COOH + NH_3 \quad (5)$$

Glutamic acid can here act as a hydrogen carrier. This is a special modern example of the so-called Krebs' dismutations of α-keto acids in which carbon dioxide arises by decarboxylation of one molecule with simultaneous formation of the corresponding hydroxy acid from another molecule. In this paper we get the first introduction to one mechanism for the formation of carbon dioxide, probably a subsidiary one. In other cases in bacteria Dr. Krebs alluded to the use of succinic acid as a hydrogen carrier in the oxidation of acetic acid, part of the C_4 catalytic system being so employed. Dr. Mann's contribution should have dealt not only with the processes of H transfer involved in fermentation and respiration, but also with that of phosphate transfer; attention was directed to the coupling of oxidations with phosphorylations recently shown by Meyerhof, Needham and Lipmann, and to the fact that these reactions can be studied with advantage in tissue brei in which the fundamental cell organization has been destroyed.

With the contribution of Dr. J. H. Quastel (Cardiff), we turn to the reactions of the organized tissue respiration system (as found in the brain-slice) to the action of narcotics. Though it has been long considered that narcosis was due to diminished oxidations, it has only recently been emphasized by his school at Cardiff that narcotics have specific effects on tissue oxidizing systems; at low concentrations they greatly inhibit the oxidation by brain tissue of glucose, lactate and pyruvate, but not that of succinate or α-glycerophosphate, leaving cytochrome oxidase unaffected. Their inhibiting effects on brain respiration in the presence of glucose are definite at concentrations of narcotic which would be narcotizing *in vivo*; and with several narcotics the effects even on the tissue slice can be proved to be reversible. Though anaerobically there is no inhibition of pyruvate dehydrogenation by low concentrations of narcotics, in presence of oxygen there is marked inhibition; this may be related to the cocarboxylase (or ? diaphorase). These experiments were carried out with pyocyanin and ferricyanide. In a new point, they had found that suspensions of bacteria grown in media deficient in vitamin B_1, and suspended in pyruvate, showed a stronger inhibition of oxygen uptake by narcotics in absence of added vitamin B_1.

While Dr. Quastel's paper showed how tissue respiration could be altered by the action of drugs, Prof. Raper dealt with the equally fundamental and fresh point of how *in vivo* the cell controlled the rate of its respiration; How is the increased respiration consequent upon tissue activity regulated? He described experiments with slices of cat's submaxillary gland; the oxygen uptake is markedly stimulated with acetylcholine, this stimulation being inhibited by atropine. This important observation brings the whole question into relation with modern work upon the nervous system in its relation to these two substances, and forms a further valuable and much needed 'bridge' study. Acetylcholine did not affect anaerobic glycolysis though it slightly increased aerobic glycolysis. The effect of atropine suggests that acetylcholine does not act by increasing the available substrates, but rather by changing the availability of the catalysts concerned. (I think that this may have interesting relations to the address by Prof. E. K. Rideal upon surface film action.)

The question of carbon dioxide production through one of the main channels for this in

tissue respiration was dealt with by Dr. S. Ochoa (Oxford), namely, the oxidation of pyruvic acid ($CH_3.CO.COOH$). There is a strong probability of a common path of carbohydrate breakdown to the pyruvic acid stage; the phosphorylated triose is oxidized anaerobically by dismutation, aerobically by giving up hydrogen to the cytochrome system through coenzyme I, flavoprotein and C_4 dicarboxylic acids. The phosphorylated oxidation product (phosphoglyceric acid) yields pyruvic acid which anaerobically is reduced to lactic acid, but aerobically is decarboxylated and oxidized; this gives, so far as is known, the main reaction in which carbon dioxide is liberated in the cell, and so forms the main source of respiratory carbon dioxide. It is catalysed, as has been shown for brain in Oxford, by cocarboxylase (vitamin B_1 pyrophosphate). (1 mol. cocarboxylase catalyses optimally the uptake of 1,500 mol. oxygen, producing 2,000 mol. carbon dioxide per min.) For complete oxidation inorganic phosphate, fumarate, adenylic acid and coenzyme I are required. During oxidative decarboxylation in brain brei, there appears to be an unstable C_3 intermediate which may appear as acetic acid in the absence of the rest of the enzyme system. There is some indication of a possible cycle of phosphorylation of pyruvate beyond this stage. Recent available evidence suggests that when dialysed brain preparations are incubated aerobically with fluoride, some inorganic phosphate disappears and a phosphate ester (not phosphopyruvate) accumulates in equivalent amounts only if pyruvate is present.

Striking a much more practical note, Dr. E. P. Poulton dealt with the question of local tissue anoxia in arterial disease and its treatment with oxygen, by the use of an oxygen tent. The improvement in the oxygen saturation of the tissues *in vivo* was of the greatest value in conditions such as rheumatism, a man being kept in the tent for days on end. That this is related to the oxidation changes in the tissues is shown by the fact that a high level of blood lactic acid, which would be caused by tissue anaerobiosis, is much reduced.

To summarize, it may be said that, with the exceptions mentioned in the opening address, the whole field of tissue respiration was well covered in summary form as it stands at the present time. As compared with twenty or even five years ago, the advance is truly marvellous and forms a fitting further chapter to the accurate knowledge of the carriage of oxygen and carbon dioxide in the blood, which has formed until now a main line of physiological research and thought upon respiration. From the purely chemical as distinct from the biochemical point of view, the strange medley of substances assembled by the cell to form the complex of catalytic systems necessary for the combustions in the tissue must always appear without logic and in strong contrast to the ordered schemes of pure organic chemistry. They will only receive a chemical meaning when we know more about the details of electron activation and exchange. Then we may be able to understand better why catalyses requiring low conditions of temperature and comparatively neutral reactions necessitate the compounds which we find. Until then, with biochemists, we can merely continue to record and wonder, and to enjoy the opportunities of intellectual interest to scientific workers of varied outlook which are presented by a study of this subject; actually it lies at the basis even of the material foundation of thought.

NOTE.—I am grateful to Dr. M. Dixon for access to the manuscript of his proposed address, and also to Dr. S. Ochoa for valuable notes of the proceedings at the meeting.

TWO BRITISH EXPEDITIONS TO UBEKENDT ISLAND, WEST GREENLAND

BY DR. H. I. DREVER, UNIVERSITY OF ST. ANDREWS

THE motive directly responsible for the organization of two British expeditions, the Cambridge West Greenland Expedition, 1938, and the St. Andrews University West Greenland Expedition, 1939, to West Greenland, was the inviting geological problems of Ubekendt Island (see Fig. 1) first encountered in 1937[1]. It was clear to me that apart from geological research, other work could also be undertaken in the same area, and that a party with a varied programme would offer, among other things, the further intrinsic interest of an 'expedition', the successful organization and conduction of which is in direct relation to the best working conditions and congenial co-operation. It is, in itself, a real problem in a non-scientific sphere.

Apart from the detailed geological examination of Ubekendt Island and similar work in parts of Upernivik Island, psychological, ethnological, archæological and botanical work was carried out, and

high-altitude balloons flown in 1938[3] and, again in addition to geology, a small area in the south of Ubekendt Island was surveyed in 1939.

A detailed geological study of Ubekendt Island and also an extension of the work regionally in Nugssuaq south and in Svartenhuk north of the island had been planned in 1938. The rocks of these areas largely belong to the Tertiary Igneous Series. Geological work on Ubekendt Island was of first importance, but it was clear that the study of such an isolated area must necessarily be supplemented by more extended observations on a regional scale. This regional work was curtailed in favour of a Danish geological expedition under A. Rosenkrantz, although the Cambridge expedition was in no way restricted by the Greenland Commission for Scientific Research. Eventually it was thought fit to withdraw entirely British geological 'interests' in the regional aspect of the problems. Accordingly, in 1939 further work was confined to the areas examined in 1938, while a relatively large Danish expedition devoted its attention to the more extensive areas of Upper Cretaceous and Tertiary rocks (see Fig. 2 in black).

Recent research on the Scottish, Icelandic and East Greenland Tertiary igneous rocks has been of great petrological value, particularly that of H.M. Geological Survey. It was the purpose of the two expeditions to further our knowledge of this—the North Atlantic—Petrographical Province.

Fig. 1.

FROM THE *Geographical Journal*, **94**, 388 (NOVEMBER 1939).

Ubekendt Island is composed essentially in the north of basic lavas and an intrusive complex of granite, gabbro and acid dykes in the south. Pyroclastic rocks are almost confined to the west coast near the remnant of a large volcanic neck. Cutting the lavas over the whole island are a large number of basic dykes with a local and variable rather than a constant regional trend. Representative collections have been made of all the rock types and the island has been geologically mapped.

Upernivik Island, on the other hand, is mainly Archæan orthogneiss, except in the south-west corner, where Cretaceous-Tertiary grits, sandstones and shales are faulted against the gneiss. A number of basic dykes and sheets cut the sediments, and there is one large sheet between 40 ft. and 60 ft. thick which has, in one place, a gabbroic centre. This area has been examined in some detail. Excursions were organized round the island, through the centre, up three of the western glaciers and the highest peak (6,893 ft.).

The psychological work was conducted in Igdlorssuit, the outpost settlement on the east coast of Ubekendt Island, and also in Umanak, the administrative centre of the district. The natives were the subject of experiments in social psychology, three individual tests were used and a study was made of group-contacts referring in particular to the relationships between Europeans and the Greenlanders. Some ethnological work was

(*Continued on page* 1083)

NATURE

SUPPLEMENT

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SHORT REVIEWS

Agriculture and Horticulture

Los Suelos de la Peninsula Luso-Ibérica (Soils of the Lusitano-Iberian Peninsula) (Spain and Portugal)
By Emilio H. del Villar. International edition in Spanish and English; the English Text (somewhat abridged) by Prof. G. W. Robinson. Pp. 416. (London: Thomas Murby and Co., Ltd., 1937.) 40*s*. net.

THE problem of devising a universally applicable system of soil classification calls for a wide knowledge of the soils found in different parts of the world as well as an intimate acquaintance with soils in the field. An attempt at devising such a system is made, by a pedologist with both these qualifications, in Prof. del Villar's work on the soils of Spain and Portugal.

Prof. del Villar groups soils according to their stratigraphy, composition and metabolism, choosing those factors which most directly affect vegetation. Seven main series are distinguished, including acid-humic, siallitic, calcareous and hydropedic groups. The calcareous series, which embraces rendzina, terra rossa and the peculiarly Spanish *calvero* soils, is perhaps the one which will prove of most interest to soil workers beyond Spain, since information on soil processes under Mediterranean conditions is still comparatively meagre.

The somewhat refreshingly unorthodox system of classification described appears to fit the soils of the Peninsula adequately and satisfactorily, but it is doubtful whether it could be generally applied to soil groups occurring elsewhere. Prof. del Villar's exposition of his system of classification includes many ideas and points of view which throw a new and constructive light on the difficulties of soil taxonomy, and the book is one which students of this comparatively undeveloped branch of pedology would do well to study.

The book is printed in Spanish, but it contains abridged English translations of each chapter, in which Prof. del Villar's views are clearly set forth. The translator, Prof. G. W. Robinson, in a prefatory note, adds tribute to the importance of the work, which, he says, must inevitably modify current ideas on soil genesis and classification.

The Soils of Palestine
Studies in Soil Formation and Land Utilization in the Mediterranean. By Dr. A. Reifenberg. Translated by Dr. C. L. Whittles. Pp. viii+131+8 plates. (London: Thomas Murby and Co., 1938.) 14s. net.

THIS authoritative account of soil conditions in Palestine, the outcome of thirteen years uninterrupted work at the Hebrew University, Jerusalem, is opportune. Part of the book is devoted to a description of soil formation within the framework of the Mediterranean type of weathering. The intense summer insolation destroys most of the soil organic matter and causes a predominantly upward movement of water containing silicic acid, ferric oxide and alumina. It is maintained that the colloidal silicic acid exerts a peptizing effect on the latter, and this accounts for their translocation in the presence of calcium during the formation of terra rossa on limestone. Terra rossa profiles are described, and theories of their formation with reference to rock weathering under different climatic conditions are discussed.

In dealing with the agricultural utilization of the soils it is emphasized that, since moisture is the main factor limiting crop production, irrigation is essential, and its success depends on the choice of water in which the concentration of salts is low enough to avoid injury to crops.

One of the most striking examples of the recent intensification of agriculture in Palestine is afforded by the citrus industry, the growth of which has revolutionized the whole of the country's agriculture. This progress is mainly due to the Zionist colonization, of which an account is given in the final chapter.

A. J. L. L.

Diseases of Bulbs
By W. C. Moore. (Ministry of Agriculture and Fisheries: Bulletin No. 117.) Pp. vi+176+20 plates. (London: H.M. Stationery Office, 1939.) 4*s*. net.

THE need for this book was great. Advisory mycologists, teachers of horticulture, and gardeners had to search for any knowledge about the diseases of bulbs among scattered journals in several languages. The almost dramatic expansion

of the bulb industry in Great Britain, moreover, brought new problems in pathology, and it would be no exaggeration to say that disease occurrences had over-run mycological information.

Mr. Moore's volume is worthy of the occasion; it deals in great detail with fungal and virus parasites of all the commoner bulbs and corms of horticultural commerce, it illustrates the descriptions with fifty-eight excellent half-tone plates, and it considers several physiological irregularities akin more to ailments than to actual disease. The practical grower will find no difficulty in separating the descriptions of symptoms and control measures from the more technical matter, which the mycologist will find quite adequate to his purpose.

A list of 709 references to the world literature on bulb diseases should satisfy any further desire for study evinced by the reader, and the international scope of the volume makes it possible to provide information in advance about any maladies which are not yet widespread in Great Britain, but which may appear later. Among all the detailed excellence of the volume, the reader will probably feel the need for an alphabetical index of parasites. The book has a description of eelworm disease, which often occurs in close association with fungal maladies.

Archaeology and Ethnology

The Maria Gonds of Bastar

By W. V. Grigson. Pp. xxi + 350 + 24 plates. (London: Oxford University Press, 1938.) 30*s*. net.

MR. GRIGSON'S anthropological investigations were undertaken largely owing to the suggestion of the late Sir Montague Butler; but his immediate objective in his contact with them was the remedy of certain grievances, more especially those caused by the application in a primitive State, of criminal, civil and revenue laws framed for British Indian districts some centuries more advanced. He found that it was by observation of their ceremonies and rituals and their daily occupations, as well as by inquiry into their family and social organization—in short through thorough-going anthropological investigation, by which science is the richer in this volume—that he was best able to arrive at their genuine and inmost opinions of, and attitude towards, the methods by which their affairs were being administered. Hence he was able, as Prof. Hutton says in his introduction, to introduce certain reforms.

Mr. Grigson's own comment on the relation of his anthropological investigation to the performance of his official duties is extremely illuminating. He points out how completely it refutes the arguments put forward by members of the Indian Legislative Assembly, in the debate on reserved and excluded areas which took place on February 18, 1936, when N. M. Joshi and M. S. Aney "heartily damned" all anthropologists as wanting to keep the primitive races in a state of barbarism as raw material for their science, and to add to their stock of knowledge. Mr. Grigson clinches the argument from his own experience by reference to the disastrous post-War attempt to force prohibition on Bhils, Gonds and Korku.

The scientific importance of this carefully detailed account of the relatively simple culture of the Marias is, however, underlined in an introduction contributed by Prof. Hutton. Dr. Ramesh Chandra Roy contributes an appendix on the physical characters of the Marias, in which he attributes evidence of a strain of brachycephaly in this predominantly dolichocephalic people to the influence of the central Asiatic or Alpine. Prof. Hutton, on the other hand, while admitting a certain subjectivity in his own view, inclines to see a Mongoloid strain, such as is present in the Assam tribes with whom he is most familiar. Turning to the cultural evidence, he supports his view in a very brief but masterly analysis of the cultural evidence.

Salween

By Ronald Kaulback. Pp. xi + 331 + 16 plates. (London: Hodder and Stoughton, Ltd., 1938.) 15*s*. net.

THE expedition to south-eastern Tibet which Mr. Ronald Kaulback describes in this volume started from Upper Burma in April 1935, and returned by way of Assam at the beginning of 1937. Of its twenty-two months duration, eighteen were spent within the borders of Tibet. The objective of the expedition was the exploration of the Nagong Chu valley, an affluent of the Brahmaputra, and the Brahmaputra–Salween watershed, as well as of so much of the course of the Salween as could be effected, with the upper waters of the Salween as the final goal. The project of exploring the hitherto unknown sources of the Salween had been formed by the author when a member of the Kingdon Ward expedition of 1933.

Unfortunately, this final piece of exploratory work had to be abandoned. Three months delay, while the further progress of the expedition was referred to Lhasa, made success too problematical. Not only was it questionable whether financial resources would be adequate—all cash for the needs of the duration of the expedition had to be carried—but also it was necessary to abandon the projected line of return through unexplored country, owing to local disturbances. The expedition returned by the Salween valley. Notwithstanding the disappointment of the author and his colleague, J. Hanbury-Tracy, the value of the survey work of the expedition in country, much of which had not been trodden previously by Europeans, was recognized by the award to Mr. Kaulback of the Murchison Grant of the Royal Geographical Society.

The author's graphic narrative makes light of the difficulties and discomforts of his journey, while throwing into relief the idiosyncrasies, individual and collective, of the people he encountered on his way. He was fortunate in obtaining an intimate view of several of the Tibetan seasonal festivals and of a remarkable prophetic ceremonial under possession. The photographic illustrations are of a high standard.

Philippine Pagans

The Autobiographies of Three Ifugaos. By R. F. Barton. Pp. xxi+271+24 plates. (London: George Routledge and Sons, Ltd., 1938.) 15*s.* net.

THE three Ifugao autobiographies comprised in this volume were collected in the course of an ethnographical investigation, which lasted for the greater part of 1937, in the island of Luzon. They attain a new standard in the attempt to eliminate the point of view of the white observer in cultural investigation. The subjects, two men and a woman, were told to record matters which they considered of most interest and importance in their lives. The narrative was, of course, taken down by the author, as the narrators were both pagan and illiterate. The result is significant in every sense. The topic which bulks largest is the pre-marital sexual relation, although for the woman, its special interest was its bearing on marriage and child-birth; but the influence of omens and the social ties of kinship and propinquity are also prominent in their influence on the course of events. Head-hunting figures repeatedly but it seems to be treated as of incidental, rather than of primary importance.

The institution which is pivotal in these narratives is that of the custom of the unmarried of both sexes sleeping in dormitories, either empty or occupied houses, apart from their families, and the consequent visiting of the females by the males, adolescent and mature. It is interesting to note that the author, as a result of the employment of this method of investigation and the intimate insight it has afforded him into native mentality, has had to reconsider an interpretation of the pre-marital sexual relation which he had based upon his experience of native institutions acquired in a residence among them over a period of seven years.

Archæology and Society

By Grahame Clark. Pp. xv+220+24 plates. (London: Methuen and Co., Ltd., 1939.) 7*s.* 6*d.* net.

ARCHÆOLOGY, no less than other branches of research, has profited from the increased popular interest in the results of scientific inquiry and their application to social ends which followed on the close of the War of 1914–18. If the practical bearing of archæological aims was less immediately apparent, this was counterbalanced by a number of spectacular discoveries, of which it will suffice to recall that of King Tutankhamen's tomb in Egypt and Sir Leonard Woolley's excavations at Ur. While it is beyond question that the study of archæology has profited much and gathered strength from this enhancement of popular interest, the constant stimulus of sensation needed to keep it alive has obvious dangers which may affect the quality of the investigation.

The present excellent review of the aims and methods of modern archæological investigation is designed to supply the public outside the ranks of the specialist with the basis of knowledge requisite to enable them to appreciate the bearing of archæological results achieved in the field, as well as the technical skill and the acumen in interpretation which contribute to the result. Thus in successive chapters he deals with discovery, in which it is explained how the archæologist knows where to dig, the preservation of early remains, depending upon the survival value of different materials, the methods and aims of the actual excavation, chronology, based upon stratigraphy and sequence, and interpretation,,in that last tracing how the interest of modern archæological investigation no longer centres on the discovery of exceptional examples of the artistic products of the past, but in the reconstruction of the essential elements in the day-to-day life of the peoples of vanished civilizations.

In his final chapter on "Archæology and Society" Dr. Clark discusses certain aspects of archæological studies as a factor in modern life, and reviews briefly its relation to the development of nationalist sentiment in the smaller States which came into being after the War of 1914–18, as well as in Russia, Italy, Germany and Eire. While his readers will concur in his praise for what is being done in Eire, they will find his account of archæological activities in Russia, in which he relies on the evidence of Prof. A. M. Tallgren, more than disturbing, and probably feel that his view of the tendentious character of German theory under the Nazi regime is all too lenient.

Biology

British Purbeck Charophyta

By Prof. Thomas Maxwell Harris. Pp. ix+83+17 plates. (London: British Museum (Natural History), 1939.) 7*s.* 6*d.*

THE Charophyta have usually been regarded as a somewhat isolated group of Thallophyta, but the author of this monograph probably rightly regards them as a family of the Chlorophyceæ. Like some members of the Rhodophyceæ and Siphonales, they have left as records of their existence in past ages the calcareous clothing with which they invested their thallus. With the exception of the oospore membrane all the original plant substance has disappeared.

There are two important families in the group, the Characeæ and the Clavatoraceæ. By careful analysis of large numbers of fragmentary specimens which were extracted from the rock, the author has been able to distinguish some new and interesting types. A new genus, Charaxis, has been instituted for vegetative organs of fossil Charophyta, and one new species, *C. durlstonense*, is described. The most interesting and important part of the monograph consists of very complete descriptions of three species of the genus Clavator; *C. reidi* Groves, and two new species *C. grovesi* and *C. bradleyi*. A new genus, Perimneste, with one species, *P. horrida*, is of exceptional interest. These forms are all included in the Clavatoraceæ. There are careful detailed analyses of the construction of the thallus and the oogonia, and the descriptions are fully illustrated with photographs of a high order of excellence. Clear diagram-

matic reconstructions are also given. Some parts of the descriptions might have been improved and clarified by the use of letters and indicator lines on some of the plate-figures. On p. 22 there is a paragraph on an exceptional cortical structure. It is not clear what is meant by opposite, and the reference to the figure in the plate (Pl. III, Fig. 8) does not help, for the figure appears to bear no relation to the written description. The technique employed in the investigation is a great advance on anything used before in work on the Charophyta, and in spite of the few obscurities to which reference has been made, the author has produced what is probably the best existing description of any collection of fossil Charophytes, and has provided us with a model of how such an investigation should be conducted.

J. WALTON.

Between Pacific Tides

An Account of the Habits and Habitats of some Five Hundred of the Common, Conspicuous Seashore Invertebrates of the Pacific Coast between Sitka, Alaska, and Northern Mexico. By Edward F. Ricketts and Jack Calvin. Pp. xxii+320+46 plates. (Stanford University, Calif.: Stanford University Press; London: Oxford University Press, 1939.) 27*s*. net.

THIS delightful book, which was written chiefly for the layman interested in the seashore, deals with the littoral fauna from the ecological point of view. No scientific account of the animals is given, but most have been illustrated and their habits described. There are many beautiful photographs, though the recurring black background does not always make for clarity, and is, moreover, tiring to the eye. The sketches are variable, and one wonders whether the layman will understand a Pycnogonum or an Aplysia drawn upside down. The Latin names should have been more carefully revised; for example, *Rencira cineria* is incorrect both historically and philologically. The English reader cannot fail to note the similarity between the inhabitants of the various shore zones of California and of his own country. The species is rarely the same, but the genus often is. Even the commensals group themselves in the same way, and the description of the fat innkeeper, *Urechis caupo*, and its guests, written in the lively American style, should be read by all British marine zoologists. For more advanced readers the species are classified at the end of the volume, with references to the literature.

Animal Families and Where they Live

Written and illustrated by Arnrid Johnston. Pp. ix+27+24 plates. (London: *Country Life*, Ltd., n.d.) 7*s*. 6*d*. net.

THIS attractively produced book is composed of a series of twenty-four plates (9 in. × 12 in.), each containing coloured sketches of animals grouped under such headings as 'egg-laying and pouched mammals', 'gnawing mammals', 'primates: New World monkeys', etc. Altogether 320 animals are featured, but the title of the book is misleading in that all the animals portrayed are mammals. Opposite each plate is a short description of each animal, one useful feature (often so unfortunately ignored) being the general measurements of the animal. Also on the opposite page is a world map showing distribution. This is of great value.

The book will make a very acceptable present for any animal lover, and if used during a visit to the Zoo will be a valuable aid in studying mammals especially in relation to each other.

Palæozoic Fishes

By J. A. Moy-Thomas. (Methuen's Monographs on Biological Subjects.) Pp. x+150. (London: Methuen and Co., Ltd., 1939.) 5*s*. net.

IN view of the tremendous advances in our knowledge of the anatomy of fossil fishes during the past twenty years, the appearance of this little book should prove most opportune. A good deal of recent work, such as the classical researches of Stensiö on the Cephalaspids and Placoderms, has been published in journals not readily accessible to the average student or teacher, who will welcome the concise summary of these and equally important papers by other workers provided by Mr. Moy-Thomas. The recent work of Brough, Gross, Heintz, Kiaer, Nielsen, Säve-Söderbergh, Watson, Westoll, White and several other palæontologists, as well as that of Mr. Moy-Thomas himself, all finds a place in this volume of less than 150 pages, and the author is to be heartily congratulated upon the skill with which he has managed to reduce this mass of technical material to reasonable and readable limits. The book is at once competent, comprehensive, and concise, and may be confidently recommended to teachers and students of both zoology and geology. Evidence that it is right up to date is provided by the statement on p. 91 that the Cœlacantha start in the Upper Devonian and continue to the present day, and a reference in the list of literature to the first account in Great Britain of the recent discovery in South Africa of the living Latimeria.

The many text-figures are admirably clear and well reproduced, and there is an excellent bibliography as well as an adequate index. The general production of the book well maintains the standard set by the earlier volumes of this series of pocket monographs on biological subjects.

Essays in Philosophical Biology

By William Morton Wheeler. Selected by Prof. G. H. Parker. Pp. xv+261. (Cambridge, Mass.: Harvard University Press; London: Oxford University Press, 1939.) 12*s*. 6*d*. net.

THE late Prof. W. H. Wheeler began his career as a naturalist and later subjected his interests in living organisms to the disciplinary influence of scientific training. His philosophical outlook was conditioned not only by the naturalist's disciplined imagination arising out of a vast, first-hand acquaintance with animals and their behaviour, for he was, in addition, a great man of letters and a distinguished prose writer. His bibliography contains some 467

titles, most of them concerned with the classification, structure and behaviour of ants, but a considerable number deal with problems of embryology, evolution, parasitism and the social life of insects in general. These formal books have had great influence upon the world of biological thought, but his observations of insects in the field caused him to make incursions into psychology and sociology, and he became a master of the comparative branches of these sciences.

This book has been prepared in order to present in collated form some of Wheeler's philosophical beliefs which are distributed throughout the various scientific journals to which he contributed. The topics range from a discussion of instincts to a discourse about the dry-rot of academic biology, from the attractions of the field study of ants to biology and society. Reading them, one is reminded of the cogency of Prof. A. N. Whitehead's remarks about Wheeler when he described him as the only man he had ever known who would have been both worthy and able to sustain a conversation with Aristotle. Whilst the book stands primarily as a memorial to Wheeler, it represents a valuable addition to the world's scientific literature. T. H. H.

Outlaw of the Air

By Leslie Brown. Pp. x+246+8 plates. (London: Geoffrey Bles, 1939.) 8*s*. 6*d*. net.

THIS is an interesting account, told in the form of fiction, of the life of the great skua, a bird which is found only on the northern islands of Britain.

The author has evidently studied his subject with care, and he gives a convincing picture of the skuas at their island home. He describes them (as the reviewer has seen them do) standing on the backs of gannets flying at full speed, and forcing them to disgorge the herring they are carrying to their young; he has seen them attacking kittiwakes and even greater black-backed gulls. From a turf 'hide' he has watched the skua brooding its eggs and hatching its chicks, and a number of interesting photographs are a record of these hours of watching, although it is a pity that almost all the illustrations are over-enlarged, and thus suffer from a want of definition.

The book is thoroughly readable, and would make an acceptable Christmas present either to young folks or to their elders, and will keep the mind focused on the beauty and charm of Nature during the dark days through which the nation is passing. The book is very free from inaccurate observations, but surely a gannet (p. 93) does not "oar itself" cormorant-fashion below the surface when it fishes, but counts on the velocity of its aerial dive to enable it to approach, with closed wings, the fish beneath the surface; and when its momentum is exhausted re-emerges, still with closed wings, on the surface? Puffins (p. 52) do not arrive on their nesting islands off the Scottish coast so early as March—not indeed until the beginning of May as a rule. But these are minor criticisms, and the book deserves to be read by all who are interested in the birds of the coasts of the British Isles. S. G.

Physikochemische Grundlagen der histologischen Methodik

Von Prof. Dr. K. Zeiger. (Wissenschaftliche Forschungsberichte. Naturwissenschaftliche Reihe, herausgegeben von Dr. Raphael Ed. Liesegang, Band 48.) Pp. xi+204. (Dresden und Leipzig: Theodor Steinkopff, 1938.) 11.25 gold marks.

HISTOLOGICAL technique was once a mere rule-of-thumb affair, and there are some to whom it is so still! One stain gave red, another blue; one stained the nucleus, another cellulose; but how or why was no concern of the histologist so long as the result seemed good. But following Sir William Hardy's lead, men began to wonder how much of all their pretty preparations was artefact; and then came a growing desire to understand the rationale of fixing, staining and clearing in their chemical and physical relation to the colloids of the cell. So the histologist began to learn from the dyer the difference between an acid and a basic dye, and was some way along the road to skill and wisdom by the time he understood, for example, that a red blood-corpuscle was permeable to anions, and that eosin was, *ipso facto*, an appropriate dye.

Dr. Zeiger tells us in a couple of hundred pages the very things which the histologist now wants to know. He discusses hardening processes in relation to diffusion, permeability, shrinkage and so forth; staining as a chemical, an adsorptive, an electrostatic, or an electrocapillary phenomenon; Golgi's silver-method and its many variants and corollaries; intra-vital staining, including methods by which a single reagent may be made to differentiate various organs, tissues or cells; Ehrlich's methylene-blue, and its innumerable developments and consequences; *p*H and the ever-present need of keeping watch upon it (though without mentioning Bailey and Zirkle's work)—and many other useful and interesting things. D. W. T.

Chemistry

Revision Notes in Inorganic Chemistry

To Higher School Certificate. By E. P. Wilson and F. W. Ambler. Pp. viii+240. (London: William Heinemann, Ltd., 1938.) 4*s*.

THE object of this book is to provide a revision course in inorganic chemistry up to higher certificate standard. The opening chapter deals with the classification of the elements, and subsequent chapters are devoted to the chemistry of the elements, arranged in the groups and sub-groups of Mendeléeff's table, though not in quite the same sequence. Questions from higher school certificate examination papers are given at the ends of the relevant chapters, and the book is provided with an adequate index.

In the reviewer's opinion the authors have considered too many unimportant compounds, and have not compared sufficiently the same compounds of different elements. In addition, the notes on 'non-certificate' elements are too brief to be of value to university students and should have been omitted. A. C. C.

The Essentials of Volumetric Analysis

By John Lambert, in conjunction with A. Holderness and Dr. F. Sherwood Taylor. Pp. vii+92. (London: William Heinemann, Ltd., 1938.) 2*s*. 6*d*.

THIS book provides a suitable course in volumetric analysis for the higher school certificate examinations. Thus an account is given of the preparation and use of standard solutions of acids, alkalis, potassium permanganate and dichromate, iodine, thiosulphate, and silver nitrate in neutral and acid solution. A concise and clear explanation is also given of the theory of indicators, including adsorption indicators. A useful feature of the book, especially from the point of view of scholarship candidates, is the list of practical problems at the ends of the chapters. Atomic weights, tables of logarithms and an index are given at the end of the book.

A. C. C.

Ergebnisse der Vitamin- und Hormonforschung

Herausgegeben von E. Mellanby und L. Ruzicka. Band 2. Pp. xv+520. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1939.) 34 gold marks.

THIS survey of current knowledge in selected fields of hormone and vitamin research, of which the first volume was reviewed in NATURE, **143**, 659 (1939), maintains the cosmopolitan aspect to which we then directed attention. Four articles are in English, all from England: four are in German, one from the United States, one from Switzerland and two from Germany: three are in French, two from France and one from the Argentine.

The authoritative nature of the various contributions leaps to the eye. Profs. Haworth and Hirst write on the chemistry of ascorbic acid and its analogues: Prof. Bertrand contributes an essay on the physiological significance of manganese and other 'trace' elements: Dr. Hans Brockmann discusses the chemistry of the antirachitic vitamins, and Prof. Rominger their physiology and pathology. Prof. J. W. Cook describes the chemical and biological properties of the carcinogenic substances, while an analysis by Prof. Lacassagne of the connexion between cancer and the sex hormones is reassuring in its conclusions. Prof. Houssay and Dr. Deulofeu have some forty-five pages on the chemistry and secretion of insulin. Prof. Karrer appropriately reviews the chemistry of the flavins. Articles by Dr. Haagen-Smit on the plant growth-hormones and by Prof. Korenchevsky on the bisexual (and other) effects of pure male hormones on females make up the eleven sections of the book.

Thus it will be seen that, like its predecessor, this volume ranges from chemistry to clinical medicine, with adequate attention to the intermediate cosciences of bio-chemistry, physiology, therapeutics and pathology. A change of editorship is to be observed in the replacement of Prof. W. Stepp by Sir Edward Mellanby; one can only speculate as to where and when subsequent volumes will be published and hope that these "Ergebnisse" will not have to be included among the war victims.

A. L. BACHARACH.

ENGINEERING

Les gisements de pétrole

Géologie, statistique, économie. Par Prof. Georges Macovei. Pp. vii+502. (Paris: Masson et Cie., 1938.) 120 francs.

M. GEORGES MACOVEI is well qualified to write a text-book on petroleum since he brings to the task twenty years of experience as a lecturer at the Polytechnic School in Bucharest and thirty years of practical experience of the Carpathian deposits. He has not hesitated to consult the works of already established authorities on the subject in England, France, Germany, the United States and elsewhere, but in addition has embraced many of the precepts of his fellow countrymen, in particular those of M. Louis Mrazec, of whom he is an admiring disciple. Those who are looking for originality may therefore be disappointed, certainly in regard to text figures, only about twenty of which are entirely new out of a total of two hundred and twenty-two.

The first part of the book follows conventional procedure in petroleum text-books, and the accepted principles of petroleum origin, constitution, production, etc., are unfolded along familiar lines. The author relieves monotonous sequences of facts wherever possible by reference to practical examples he has encountered in the field; but, being most familiar with the Rumanian oilfields, he tends perhaps to over-emphasize their importance in relation to oil deposits in other parts of the world.

The second half of the book is devoted to a description of the known deposits of petroleum throughout the world. No attempt is of course made to give complete details of all deposits, but indications are in each case given of extent, yield and potential reserves.

Few writers of text-books on petroleum can withstand the temptation to estimate world resources of this product. M. Macovei succumbs in the last chapter and quotes some astonishing figures. From statistics gleaned from a variety of sources he estimates that world reserves at the beginning of 1938 were 5,173 million tons. He then proceeds to calculate on a basis of 1937 withdrawals that petroleum will be exhausted in Mexico in five years, in the United States in twelve years and in Rumania in thirteen. Even Iraq, the supplies of which are expected to outlast those of the rest of the world, will have exhausted her reserves in less than a hundred years according to this author's approximations.

Petroleum Production Engineering

Oil Field Exploitation. By Prof. Lester Charles Uren. Second edition. Pp. ix+756. (New York and London: McGraw-Hill Book Co., Inc., 1939.) 36*s*.

THE fact that Prof. Uren has had to expand the first edition of this work, which he wrote fifteen years ago, into two volumes and approximately twice as many pages is yet another indication of the steadily accumulating mass of technical knowledge now available to the petroleum industry. The work

is of necessity still academic in its bias, but, if thoroughly digested by students during their university course, must provide an excellent preliminary to practical experience in the field. It may also prove useful as a book of reference for those who have already had practical experience in the industry and yet desire to consolidate their knowledge in terms of academic principles.

Statistical Year-Book of the World Power Conference
No. 3: Data on Resources and Annual Statistics for 1935 and 1936. Edited, with an Introduction and Explanatory Text, by Frederick Brown. Pp. 138. (London: World Power Conference, 1938.) 20*s*. net.

THE same principles are followed in this third Year-Book as in No. 1 (1936) and No. 2 (1937), the ultimate aim being to give *comparable* statistics of world power resources. Two noteworthy advances have, however, been incorporated in this volume, quite apart from progress made towards publication of complete statistics for the whole world. For the first time a table is included at the beginning of the volume showing the area and population of most of the countries from which statistics have been obtained. Also there is clear indication that the several countries have made a greater effort to return statistics in conformity with definitions adopted by the World Power Conference.

Mathematics

Tables for Converting Rectangular to Polar Co-ordinates
By Dr. J. C. P. Miller. Pp. 16. (London: The Scientific Computing Service, Ltd., 1939.) 2*s*.

DR. J. C. P. MILLER has compiled these tables to facilitate the conversion of rectangular to polar co-ordinates, and after several years of experiment he is convinced that they afford the maximum efficiency. Acknowledgment is made of the advice and assistance of Dr. L. J. Comrie both in the computation and publication of the tables. A full description of the method of application with a computing machine and also with a slide rule is given, and, generally speaking, only one set-up of the machine or rule is necessary. Where maximum accuracy is essential, two settings are sometimes required with the slide rule, and examples are given which show the various degrees of accuracy that arise with one or two settings. The tables have already been extensively used in manuscript form for the transformation of harmonic constants a and b, obtained by harmonic analysis, to amplitude c and phase angle ϵ, in accordance with the relation

$$c \sin(nt + \epsilon) = a \sin nt + b \cos nt.$$

As further applications may be mentioned the evaluation of the magnitude and direction of a vector from rectangular components, and the conversion of complex numbers from the form $x + iy$ to the form $re^{i\theta}$.

The tables will be very useful in various branches of applied science.

Trigonometry, with Tables
By Prof. Howard K. Hughes and Glen T. Miller. Pp. viii+190+79. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1938.) 7*s*. 6*d*. net.

TEACHERS of elementary trigonometry may discuss the order in which to introduce the tangent, the cosine, and the sine, and there are substantial and interesting arguments in favour of each as the first to be studied, but there has been general agreement for many years that in a first course the tangent and the sine or cosine should be introduced separately, whether the actual definitions are in terms of right-angled triangles or of co-ordinates. It is typical of the teaching of Messrs. Hughes and Miller that they throw the six circular functions simultaneously at the pupil's head at the very beginning, and this implies, on the kindest interpretation, that the subject has been deferred far beyond the age at which the elements of it can profitably be studied. We need scarcely give other reasons for doubting whether this text-book is suitable for the use for which it is intended. On principle, the inclusion of a chapter on spherical trigonometry is to be commended, and an attractive set of tables is paged independently at the end of the volume. The printing and production are exceptionally good. E. H. N.

Miscellany

Bibliographie de Maurice Maeterlinck
Littérature, science, philosophie. Par Maurice Lecat. Pp. 208. (Bruxelles: Libr. Castaigne, 1939.) 35 francs.

M. MAURICE LECAT, the relentless and indefatigable critic of the "Belgian Shakespeare", has issued separately the bibliography which forms part of his work entitled "Maeterlinckisme", of which the first volume was published in 1937 and the third is to appear shortly. The bibliography consists of two parts devoted respectively to works by or about Maeterlinck. Appended is a bibliography of the publications of M. Lecat, who is a doctor in mathematical and physical sciences, a mining engineer, and a laureate of the Académie des Sciences.

The Psychology of Physics
By Blamey Stevens. Pp. xvi+282. (Manchester: Sherratt and Hughes; New York: G. E. Stechert and Co., 1939.) 7*s*. 6*d*. net.

NEITHER the psychology nor the physics of this book is of the conventional type. In a previous book, "The Identity Theory" (1936), Mr. Blamey Stevens put forward views which are now presented in a simpler form. To begin with, he suggests that space and time have no objective reality, and are merely two different subjective or *perceptual* aspects of an identical thing, which may be called substance. On bases such as these, a complete perceptual theory of physics is built up, rejecting many of the accepted laws, but replacing them by others which, it is claimed, are in accordance with empirical facts.

Ethics in Modern Art

By Marjorie Bowen. (Conway Memorial Lecture delivered at Conway Hall, Red Lion Square, W.C.1, on April 19, 1939.) Pp. x+50. (London: Watts and Co., Ltd., 1939.) Paper, 1*s* net; cloth, 2*s*. net.

THIS lecture must have been a stimulating and provocative discourse, for surely many hearers must have itched to refute and debate its many inconsistencies. For example, while apparently condemning 'escape' stories, Miss Bowen praises the effect of music and poetry in taking us away from our petty troubles, trivial fears and everyday worries—surely an appeal for 'escape'.

The reviewer feels that, while admitting the complete freedom of modern art, plastic or otherwise, Miss Bowen would seem to consider that this freedom should be one-sided, and that the percipient of art should support monetarily that which to him is repulsive.

For art to have an ethical value, we must surely have some *rapport* between artist and percipient. If the artist can use his keener vision in such a way as to reinforce that of the percipient, then we admit his power, ethical or the reverse, in influencing his fellows. But the public liking for purely objective stories and pictures seems to show that the artist of the more intense school has lost rapport with the normal man, who dismisses the detailed character study and self-representation school as long-winded and faintly repulsive. The many works of this nature are meat for the few, and the rest of the world will ignore them.

Miss Bowen pleads for æsthetics in education: "Children could be taught æsthetics, to understand and to value the work of the artist. . . . Children should see, hear and read the ugly, the trivial, the silly as little as possible". Surely this was the system of the Victorians, used according to their lights, which produced the intolerance of novelty so deplored by Miss Bowen. On the same page we are told that the child is not to study great poets, nor to have fine music offered it, nor have great pictures analysed for it. As æsthetics are to be studied, and the great and the trivial alike are to be avoided, we have here the apotheosis of mediocrity.

There is much in the lecture with which all must agree, and the rest of it, being controversial, arouses the more interest.

Psychology

Incentives and Contentment

A Study made in a British Factory. By Patricia Hall and H. W. Locke. Pp. xii+190. (London: Sir Isaac Pitman and Sons, Ltd., 1938.) 2*s*. 6*d*. net.

THIS book describes the results of some research work carried out in a pioneer factory, which has attempted to put into practice a system of democratic government. The object was to discover those factors involved in the production of good work allied with contentment.

An analysis was made of the factors around which satisfaction and discontent centre; for example, remuneration, promotion, suitability for the job, the value of creative work, conditions inside and outside the working situation. The many motives that might play a part in actuating human endeavour were also considered. Lastly, the important subject of leadership, both managerial and in the workroom, was discussed, and this led on to the subject of the 'difficult' employee.

There is an interesting reference to the psychological department, which endeavours by vocational studies to reduce the number of maladjusted workers, by taking into account such factors as temperament, ability, interests.

This research has shown quite clearly that if incentives are to be effective, and contentment real, they must be contingent upon the satisfaction of those abiding instincts and desires that are present in every man and woman. It also emphasizes the importance of selecting for managerial posts people who have the power of leadership and can enter sympathetically into the point of view of their subordinates.

The book is one to be recommended to all students of industrial problems.

Fifty Years of Psychical Research

A Critical Survey. By Harry Price. Pp. xii+383+15 plates. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1939.) 10*s*. 6*d*. net.

ALTHOUGH this work purports to be a critical survey of the work undertaken by psychical research workers during the last fifty years, and even to be a continuation of the late Mr. Frank Podmore's history of modern spiritualism, it is, if the truth be told, nothing of the kind. It consists of a miscellaneous collection of material, written in a popular style and forming more than anything else a kind of abstract or digest of some of the more sensational cases of recent times. There is no attempt to present the subject-matter in historical sequence with due regard and appreciation of the factors underlying the changes in technique and experimentation during the course of time, and moreover a good deal of space is given to accounts of cases of no conceivable scientific or even historical importance, whilst others of considerable psychological value are omitted altogether.

Regarded as a well-documented and popular guide to the less serious side of psychical research during the last fifty years, this work will doubtless fulfil a useful purpose; but it cannot be claimed that it is in any sense a well-balanced, historical or critical account of a period in psychical research when much has been done and foundations laid for a better and more scientific approach to the problems in dispute. In order to meet this claim, what is required is a long and detailed account of the work accomplished, together with a running commentary dealing with the developmental history of experimental methods and a careful evaluation of the results obtained, with suggestions for improving both technique and constructive criticism. E. J. D.

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(*Continued from page* 1074)

undertaken in Igdlorssuit. An examination of five ancient habitation sites was made on Ubekendt Island, and two of these, on the south and south-west coasts, were very productive of material. In the more easterly of the two sites, two houses were excavated and showed traces of both Eskimo and European cultures. The latter is of eighteenth century origin and the former up to two centuries earlier.

A collection of 405 plant specimens was obtained for the British Museum in 1938, chiefly from Ubekendt Island.

In continuation in 1938 of the work by Carmichael and Dymond[3], a number of pilot balloon flights were made. Evidence was obtained confirming the work of the previous year, very small wind velocity being again noted in the stratosphere at heights above 15 km. and a velocity maximum about 9 km. in the troposphere. The single theodolite (R.A.F. type) method was employed on the assumption that the balloons rose at constant rate. The same type of balloon was used as in 1937.

Longitude and latitude observations made at Igdlorssuit by means of a Watts 3¼-inch micrometer theodolite indicate that the position of Ubekendt Island is correctly shown in the existing charts and maps. The topography of this island and also that of Upernivik is very inadequately and sometimes wrongly represented. A detailed plane-table triangulation on the scale of 1 : 50,000 was made of a small area embodying the most interesting geological features on the southern half of Ubekendt. Observations taken during excursions on Upernivik will amplify the topography and correct some errors.

Finally, it is thought desirable, on the whole, that work along similar lines should be encouraged, and, with the permission of the Greenland Administration, continued.

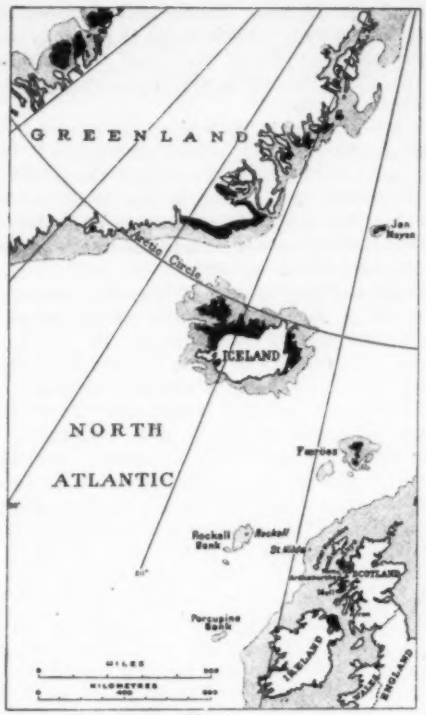


Fig. 2.

REPRODUCED FROM "SCOTLAND: THE TERTIARY VOLCANIC DISTRICTS", BY DR. J. E. RICHEY, BY PERMISSION OF THE CONTROLLER OF H.M. STATIONERY OFFICE.

[1] Wordie, NATURE, **140**, 1083 (1937); *Geogr. J.*, **92** (1938).
[2] Drever, *Geogr. J.*, **94** (1939).
[3] Carmichael and Dymond, NATURE, **141**, 910 (1938); *Proc. Roy. Soc.*, A, **171**, 345–359 (1939).

OBITUARIES

Prof. W. Lindgren

PROF. WALDEMAR LINDGREN, deeply respected by all mining geologists, died at Brookline, Massachusetts, on November 3 at the age of seventy-nine. He was born at Kalmar in Sweden, and, after a general education in his own country, qualified for the diploma of mining engineer at the well-known *Bergakademie* of Freiberg in Saxony. In 1884 he emigrated to the United States, and soon after was appointed an assistant on the United States Geological Survey, where he passed through successive grades to be chief geologist in 1911.

Lindgren's field work was mostly done on the mining fields of the western States, in Arizona, California, Colorado, Idaho, Oregon, and Utah, his results being described in a series of remarkable memoirs which were characterized by carefully detailed records of the geology and mineralogy of the ore deposits, supplemented always with cautiously restrained excursions into the field of theory regarding their origin. On the data recorded in these earlier papers was built up the theory of 'secondary enrichment', especially of sulphide-ore deposits; for he noticed that the solutions formed by meteoric waters near the outcrops of the lodes passed down along the ore-bodies, and became deoxidized at greater depths preparatory to re-precipitation of the metals as sulphides by reaction with the primary ores at lower

depths in the deposits. The theoretical aspects of this question and their variations due to previous changes in the physiography of the areas were afterwards discussed by Lindgren in various papers published in *Economic Geology*.

At a later stage in his long career of activity, and based partly on a study of the tin deposits in Bolivia and elsewhere, Lindgren formulated the principles of metasomatism as a process in the formation of ore-deposits. This subject he analysed in all its theoretical aspects in his presidential address to the Geological Society of America in 1925.

Occasional by-products of his main line of work appeared as descriptions of new mineral species and new occurrences of known forms. He was the first to recognize analcite as a primary mineral in igneous rocks, and this led to the necessity of re-examining the colourless, isotropic substances previously assumed to be residual glass in many basalts.

In 1912 Lindgren was appointed professor of economic geology at the Massachusetts Institute of Technology, and in the following year he published the first edition of his comprehensive treatise on "Mineral Deposits". In 1933 he retired from his chair after twenty-one years of distinguished service; and Prof. Palache, the eminent mineralogist at Harvard, two years later took the opportunity of giving the name lindgrenite to a new natural molybdate of copper, in the year in which Lindgren received also the honorary D.Sc. from Harvard. At "Technology", as the Institute is locally known, Lindgren's name is deeply respected, and is there preserved as the name given to the library of mining and geology. In 1933 he was elected president of the International Geological Congress, and two years ago the Geological Society of London conferred on him the highest honour at its disposal, the Wollaston medal, which has the peculiar interest of being struck in palladium, the relatively rare metal first isolated in 1802 by W. H. Wollaston.

Lindgren's massive record of facts about mineral deposits has been and will be extended by others; but it is unlikely that his theoretical deductions will ever undergo serious change, for he was too wise to stray beyond the deductions immediately justified by the facts, and he knew far too much about his subject to regard any present theory of ore-deposits to be complete to the exclusion of all others.

T. H. HOLLAND.

Prof. W. P. Lombard

THE death of Warren Plimpton Lombard at the age of eighty-four years removes one of the last direct links between the laboratory of Carl Ludwig and experimental physiology in the United States—a link with which American physiologists, like those of Britain, have always been proud. Born on May 29, 1855, the son of Israel Lombard by his wife, Mary Ann Plimpton, he was descended on both sides of his family from Puritan stock which had emigrated to the American continent early in the seventeenth century. He was born and spent his boyhood in West Newton, Massachusetts, and obtained his preparatory education in the public schools of that town. He received his baccalaureate degree from Harvard in 1878; and also an M.D., Harvard, in 1881.

On the advice of Henry Pickering Bowditch, who was a pupil of Ludwig as well as the first experimental physiologist of Harvard, Lombard went to Leipzig in 1881 to spend three years in the stimulating and liberal atmosphere of Carl Ludwig's laboratory. There he became interested in muscular contraction, in spinal reflexes and in the various recording techniques which Ludwig had devised and of which he was an accomplished master. His first paper, published from the Leipzig laboratory, dealt with the sequence of contractions of various muscles of the hind limb of the frog under reflex stimulation (*Arch. Anat. u. Physiol.*, 408; 1885). He designed elaborate recording myographs which made possible simultaneous records of as many as twenty muscles attached simultaneously to the lever system.

Lombard was one of the first after Descartes to consider the problem of reciprocal innervation of antagonistic muscles. Later he studied the knee-jerk, vasomotor reflexes, skin temperature and its control; and his successor, Robert Gesell, states that much of Lombard's time during his early years was devoted to the study of the mechanics of two-joint muscles (see *Amer. J. Physiol.*, **20**, 1; 1907). "The fact that a two-joint muscle can make use of the tendon action of another two-joint muscle on the opposite side of the leg accounts for the paradox that a two-joint muscle, when in a position to have a stronger extensor than flexor leverage, may extend a joint of which it is a flexor". He was likewise interested in respiration and worked out a balance sufficiently sensitive to record the minute changes in weight incident to the fluid loss which accompanied each expiration. His technique for observing capillary circulation in man has been almost universally adopted in the many subsequent studies carried out in this field. As a teacher he followed Ludwig in being an ardent exponent of 'practical' laboratory instruction, and few better laboratory guides have ever been written than his "Directions for Laboratory Work in Physiology for the use of Medical Students (2nd ed. 1914).

On returning to the United States from Europe, Lombard became an assistant in physiology at the College of Physicians and Surgeons in New York City. Thereafter he went back to Europe for several years and on reaching America again in 1889 he accepted the appointment of assistant professor in physiology at Clark University in Worcester, Massachusetts. In the same year, William Howell took the chair of physiology at Michigan as successor to Henry Sewall, whose health had forced him to abandon the inclement weather of Michigan for the clearer and warmer climate of Colorado. Howell was called to Johns Hopkins in 1892 and Lombard was then asked to fill the chair of physiology at the University of Michigan, where he remained until his wife's death in 1923, at which time he retired.

Lombard was a warm and friendly person, who had wide interests apart from science, and in the

years between his retirement and his death he devoted himself to drawing, water-colour painting and etching. He spent his summers at Monhegan, Maine, and his friends paid tribute each year to his increasing artistic skill. Shortly before his death, he read a paper to a scientific club in Michigan in which he characterized himself in the following terms: "I have always been an optimist and I cannot claim to have ever been religious. I have thoroughly enjoyed life and feel that the finest one can do is to bring pleasures into the lives of others. In this I find a worthy reason for living and shall be glad to live as long as I can enjoy life and help others to do so."

J. F. FULTON.

WE regret to announce the following deaths:

Mr. George Eumorfopoulos, the well-known collector of Chinese porcelain and other examples of Oriental art, on December 19, aged seventy-six years.

Prof. Eduard Fischer, professor of botany in the University of Bern from 1897 until 1933.

Senatore Prince Ginori Conti, a well-known Italian industrial chemist, on December 3.

Prof. A. J. Hopkins, emeritus professor of chemistry in Amherst College, known for his work on the early history of science, on November 10, aged seventy-five years.

NEWS AND VIEWS

Scientific Research and Technical Development

AN Advisory Council on Scientific Research and Technical Development has been set up by the Minister of Supply to advise him on scientific and technical problems. The main functions of the Council will be to ensure that the work of the Directorate of Scientific Research is carried out with due regard to recent advances in scientific knowledge, to introduce new fields of research and development, and to make recommendations regarding the most effective use of scientific personnel. The chairman of the Council is Lord Cadman, emeritus professor of mining and petroleum technology in the University of Birmingham, chairman of the Anglo-Iranian Oil Co., Ltd. and of the Iraq Petroleum Co., Ltd. The Admiralty, Air Ministry, and Ministry of Home Security are also represented on the Council, of which the joint secretaries are Mr. E. T. Paris and Mr. F. Roffey, Ministry of Supply, Adelphi, W.C.2.

THE Council is constituted as follows: Prof. E. N. da C. Andrade, professor of physics, University College, London; Dr. E. V. Appleton, secretary, Department of Scientific and Industrial Research; Sir Joseph Barcroft, formerly professor of physiology, University of Cambridge; Prof. W. L. Bragg, Cavendish professor of physics, University of Cambridge; Major-General E. M. C. Clarke, director of artillery (military adviser), Ministry of Supply; Prof. J. D. Cockcroft, professor of natural philosophy, University of Cambridge; Major-General A. E. Davidson, controller of mechanization development (military adviser), Ministry of Supply; Dr. H. J. Gough, director of scientific research, Ministry of Supply; Dr. H. L. Guy, chief engineer, Mechanical Engineering Department, Metropolitan-Vickers Electrical Co., Ltd.; Sir Harold Hartley, vice-president and director of research, L.M.S. Railway, and chairman of the Fuel Research Board; Prof. I. M. Heilbron, professor of organic chemistry, University of London; Prof. A. V. Hill, secretary, Royal Society, and Foulerton research professor (physiology); Prof. R. S. Hutton, professor of metallurgy, University of Cambridge; Sir Robert Robertson, director of the Salters' Institute of Industrial Chemistry, formerly Government chemist; Sir Robert Robinson, professor of chemistry, University of Oxford; Mr. J. Rogers, deputy director-general of explosives, Ministry of Supply; Sir Frank Smith, director of instrument production, Ministry of Supply, director of research, Anglo-Iranian Oil Co.; Prof. R. V. Southwell, professor of engineering, University of Oxford; Prof. G. I. Taylor, Yarrow research professor of the Royal Society (engineering); Sir Maurice Taylor, senior military adviser, Ministry of Supply; Sir Henry Tizard, rector of Imperial College of Science, chairman, Aeronautical Research Committee.

Early Man and his Forerunners

IN the two years 1937–39 a series of researches carried out by P. Teilhard de Chardin, Prof. Franz Weidenreich and their fellow-workers of the Cenozoic Research Laboratory of the Geological Survey of China, papers on which have only just reached Great Britain (see NATURE, December 23, p. 1054 and December 30, p. 1097) has made a notable contribution to anthropological study, not merely in so far as it deals with early man in China, but also in its bearing upon fundamental problems of the development of the human stock and the origin and distribution of its varieties. How far Teilhard de Chardin's suggested need for a revision of Tertiary and Quaternary classification in geology and palæontology will be accepted as of general application may remain in abeyance for the moment; but his brilliant synthetic study of recent geological and palæontological discovery provides a new diagnosis —in China at least—for the much-debated division between Pliocene and Pleistocene in the form of the definite break, almost catastrophic in its proportions, in fauna and physiographic conditions between the Nihowan and Choukoutien phases of the so-called Sanmenian, which is followed by the appearance of man, who in some sort, it may be suggested, now might be regarded as a characteristic fossil.

THE work of Prof. Weidenreich, more especially with the supplement of the cultural study of the contents of the palæolithic cave at Choukoutien, by W. C. Pei, offers too many points of interest for detailed comment here. One matter of special moment is the inference he draws that the important body of knowledge which has been derived from the specimens of Sinanthropus calls for "a radical transformation of our conceptions of the problem of mankind", and he then proceeds to the significant conclusion that while human development has been orthogenetic, it has also been polycentric, certain consequences following logically upon this as affecting the mode of that development, in which Lamarckian and Darwinian conceptions are set aside as unimportant in favour of an evolutionary progressive development of the type. At the same time, his remarkable diagnosis of three racial types—Melanesian, Eskimoid and Mongoloid—in a single and small palæolithic population at so early a date is scarcely less significant for the further development of racial theory at large. Mr. Pei's cultural study of this same palæolithic population affords a view of its technological capacity which is little less than surprising. This is also, be it noted, the first site in China on which cultural material of palæolithic age and human skeletal remains have been found in association.

Universities and Government Grants

IT is generally known the Government grants to the universities of Great Britain have been stabilized for a limited period from the beginning of the War. As that time approaches its end, the Government and the University Grants Committee will be faced with a difficult task. The incessant call for economy at this time of stress must be heeded. No sum that can be saved, however small it may be, is negligible in the present circumstances; indeed it may be in the multitude of minor economies that the best hope lies. Nevertheless, in the matter of the universities, great caution and careful scrutiny will be necessary. Any move which curtails the efficiency of the universities in the discharge of their duties would be sharply criticized. It will readily be granted that the undergraduate population of the universities has decreased substantially, and national service has also claimed a varying proportion of the teaching and supervisory staffs. Teaching and research must, however, still go on. Apart from present needs, there is the future to consider. When the time comes for reconstruction, the universities must be ready to expand rapidly and to play their part in building up the new order. This they can do only if they retain their efficiency throughout the days of wartime activity. The task of those in authority will be to satisfy present needs and also to enable the universities to meet their obligations to the future.

British Social Hygiene Council

IT has been found impossible to continue meetings of the full Educational Advisory Board of the British Social Hygiene Council during the War. A representative Emergency Committee has been formed, however, and held its first meeting on December 19 at Tavistock House, London, W.C.1. It was decided that the long-term policy of stimulating the development of biological education should be maintained so far as is possible. The possibilities of educational activities are to be explored on a regional basis; particular attention is to be directed towards providing short courses of lectures and talks for youth leaders, adolescents and men and women in the military forces. The development of biological education in the Colonies is being continued and negotiations for the production of text-books of biology for use in schools in East Africa should soon be completed. Tentative inquiries are also being made to determine the possibilities of holding a Summer School for teachers, if circumstances permit.

Dendrochronology in the Eastern United States

THE dream of the archæologist, for whom from the nature of his material an absolute chronology is rarely available, has been the attainment of a system of dating which should be universally valid; but diversity of conditions, as a rule, precludes anything approaching certainty when attempts are made to apply any given method of time measurement outside a more or less restricted area. For this reason much interest is attached to attempts which are being made to extend the tree-ring method of dating outside the south-western United States, where it has been applied with conspicuous success to the dating of Pueblo remains and structures. The first successful observations in the eastern United States are recorded by Prof. Charles J. Lyon, of Dartmouth College (*Science*, **90**, 419; Nov. 3, 1939), who has compared the rings of virgin white pine felled by a hurricane in September 1938 at Wolfeboro, N.H., with buried logs of the same species uncovered in an excavation at the site of an ancient bridge abutment nearby. The skeleton plot method of Douglass gave the date of 1806 for the last ring formed in the trees used to build the bridge, a result said to be "very reasonable in the light of Wolfeboro history". Further, from North Sutton, N.H., thirty-nine miles south of this bridge, a record of white pine was obtained for a 260-year period, establishing a link with the buried logs in a 128-year overlap between the outer rings of the latter and the inner rings of the Sutton trees. Although not sufficient for a standard scale, yet this marks a beginning in the formulation of an efficient instrument for the eastern archæologist; but it is noted that the identification in detail is less perfect than in the south-west. Apart from the cross-check, however, the rings agreed with a number of entries of drought in a diary.

History of Intensive Cultivation

AN interesting historical review of progress in the production of early vegetables by methods of intensive cultivation has recently been issued by R. J. G. Hopp (*J. Roy. Hort. Soc.*, **64**, Pt. 2; Nov. 1939). The first record of forcing plants appears to be in the time of the emperor Tiberius, when cucumbers

were grown in boxes of dung and sheltered during cold days with thin plates of *Lapis specularia*. Lettuce is mentioned by Charlemagne, and in the time of Albertus Magnus (1193–1280) it was grown throughout the year. From the Norman invasion of England until the middle of the sixteenth century, gardening appears to have been very greatly subordinated by the political unrest. Its development in the seventeenth century was closely bound with the herbalists Gerard and Parkinson. The initiation of French gardening, involving the protection of early plants with glass *cloches*, appears to have been due to Jean de la Quintinye in the second half of the seventeenth century, and crops were then brought to maturity upon hotbeds. John Evelyn, John Woolridge and Prof. Bradley added their quota of horticultural development in the succeeding hundred years, to be followed by J. C. Loudon. French gardening declined in the later half of the nineteenth century, however, only to give place to the more workable and convenient methods of glasshouse culture which provide our present supplies of extra-seasonal vegetables.

A New Cyclotron

THE cyclotron constructed in the workshop of the Physics Department of Purdue University, Indiana, is described in the November issue of the *Journal of the Franklin Institute* by the five members of the staff who designed it. So far as possible standard materials available in industry have been used in its construction. The magnet is of low carbon steel 3 m. long and 2 m. high, and the pole pieces of special shape 1 m. diameter. The magnetizing coils are of thin copper tube through which cold water circulates. Each coil is square in section with side 30 cm. The oscillator is of the tuned grid tuned plate type, of frequency 10·9 Mc., with neutralizing condensers. It takes 3 amperes at 8,500 volts. The chamber is of the Berkeley type with floor and top of steel plate 3 cm. thick with special arrangements for controlling the bending due to external pressure, which has been found to increase the beam intensity. The ions are supplied by an arc near the centre of the cyclotron. The instrument yields 16·5 million volts for He^{++} ions.

The National Institute for Research in Dairying

THE annual report of the National Institute for Research in Dairying, Reading, covering the year ending September 30, 1938, has just been published; this seems an unnecessarily long delay. Developments, administrative matters and changes in the staff are outlined, and a summary is given of the research work that has been carried out in the various departments. Among the last named is an investigation in the Department of Physiology and Biochemistry on the nutritive value of spray-dried milk, roller-dried milk and evaporated milk. The biological values of the proteins, and the content of vitamin A and of vitamin C are much the same for all three products, but vitamin B is much reduced in the evaporated milk—to half that present in the other two. The results show that properly dried milk retains to a remarkable extent the nutritive value of the raw product and that modern methods of spray drying yield a powder of high nutritional quality. An appeal is made for donations to meet the cost of new buildings which are urgently needed to relieve the acute congestion in the existing laboratories.

International Society of Medical Hydrology

A MEETING of the general purposes committee of the International Society of Medical Hydrology was held in London on November 17 last to deal with emergency measures made necessary by the War, and also by the death of the Society's chairman of council, Dr. E. P. Poulton. Dr. J. Barnes Burt was elected interim chairman of council, and four additional vice-chairmen, all in countries 'neutral' in the present conflict, were appointed. It was further resolved that the cash balance remaining should be set aside for reconstruction of the Society after the War, and the general secretary was given indefinite leave of absence without pay and instructed to close the London office. The Society's address will be, until further notice, that of the honorary treasurer, Dr. G. D. Kersley, 6 The Circus, Bath.

Medical Organizations of India

THE medical organizations of all-India are reviewed by Major-General Bradfield, director-general of the Indian Medical Service, in a volume of 658 pages entitled "An Indian Medical Review" (Government of India Press, New Delhi, 1938). Administrative organization and the medical profession and services, hospitals and nursing, maternity service and pharmacy, and medical education and research, are all surveyed in the first 280 pages, the remainder of the book containing full statistics of hospitals, dispensaries and other medical institutions. This volume should prove a useful supplement to the "Annual Report of the Public Health Commissioner with the Government of India".

The Night Sky in January

DURING this month, the night shortens in the latitude of London by 1 hour 10 minutes, reckoning from sunset to sunrise. The moon is new on January 9, and full on January 24. Occultations of stars by the moon include three stars of magnitude 3–4 of the Hyades cluster which precedes Aldebaran. The disappearances as seen from Greenwich take place on January 20 as follows: δ Tauri at 21h. 37·9m. at position angle 107° from the north point of the moon's disk: 64 Tauri at 22h. 31·1m. at 142° and 68 Tauri at 23h. 29·0m. at 16°. On January 23, λ Geminorum (3·6 m.) is occulted at 20h. 20·9m. at 121°. There is a fine array of planets in the evening sky—Venus, Mars, Jupiter and Saturn—whilst Uranus, a faint 6th magnitude object, is in Aries near the 6th magnitude star 53 Arietis. At the beginning of the month, Mars is overtaking Jupiter in the eastward shift of the two planets among the stars by about ½° a day, and on January 7 at 15h. there is a conjunction, the geocentric distance between

the two objects being 1·2°. It is interesting to compare the colours and magnitudes of Mars and Jupiter when close together. Lunar conjunctions with the planets occur as follows: Jan. 8d. 10h. with Mercury; 12d. 13h. with Venus; 15d. 22h. with Jupiter; 16d. 7h. with Mars; 17d. 17h. with Saturn. In mid-January at about 22h., the southern meridian is bright with the stars of Taurus, Auriga, Orion, Gemini, Canis Minor and Canis Major. The Great Nebula of Orion shows to the naked eye as a hazy patch. The photographic plate is required to show the nebulosities, which, enveloping the Pleiades, are but the central condensation, according to Barnard, of an enormous nebula covering at least 100 square degrees. Not far from φ Tauri is a dark nebulous region giving the strongest proof, according to the same authority, of the existence of obscuring matter in space. Near ζ Tauri is the so-called Crab Nebula, which is No. 1 in the catalogue of 103 nebulæ drawn up in 1781 by Messier for his own use when searching for and identifying comets.

Announcements

THE Royal Meteorological Society's Symons Gold Medal for 1940 has been awarded to Prof. Dr. J. Bjerknes of the Geofysiske Institutt, Bergen.

THE Secretary for Mines has appointed Lord Cadman to be honorary adviser on oil, and Sir Harold Hartley to be honorary adviser on the development of home-produced fuels.

THE Minister of Health and the Secretary of State for Scotland have jointly appointed Dr. Edward Ellice Henderson, a medical officer of the Ministry of Health, to undertake the duties of inspector of anatomy in England, Scotland and Wales.

IT is of interest to put on record that Major-General A. G. L. McNaughton, commanding the Canadian Active Service Force which has recently landed in Great Britain, is a science graduate of McGill University and was president during 1935–39 of the National Research Council of Canada.

THE popular series of Gaumont British Instructional Films called "Secrets of Life" have now been made in colour using the Dufay process, and three of the present series of six were demonstrated at Film House on December 20. The valuable teaching aid that colour gives in educational films was apparent, and although many technical difficulties remain to be overcome, these films portraying the life-history of the burnet moth, the genetics of the lupin, the habits of badgers and other subjects have already reached a high level of efficiency. Mr. Oliver Pike's photographs in the badger film represent a real contribution to natural history.

DR. GEORGE W. CORNER, who has occupied the chair of anatomy in the University of Rochester (New York) since 1924, has been appointed director of the Department of Embryology, Carnegie Institution, Washington, D.C. He succeeds Dr. George Streeter, who has done so much to give the Department of Embryology of the Carnegie Institution its high place in the estimation of embryologists in all parts of the world. Dr. Streeter, who now retires, succeeded the first director—the late Prof. Franklin Mall. Dr. Corner's appointment has the warm approval of his fellow embryologists.

SIR WALTER LANGDON-BROWN has been appointed president of the British Social Hygiene Council in succession to the Right Hon. L. S. Amery, M.P.

A CHILD Guidance Clinic providing a limited service is available at Guy's Hospital for the hospital area.

ACCORDING to official statistics of the last fifty years, there has been a considerable reduction in the tuberculosis mortality in Germany. In women the mortality per 100,000 has fallen from 28·4 to 6·4 and in men from 34·2 to 7·8.

ACCORDING to the latest provisional figures issued by the United States Bureau of Census, the infant mortality reached a record low level of 50·9 per 1,000 live births in 1938, as compared with 54·4 in 1937. The rate has been decreasing steadily for twenty years: in 1915, when the birth registration area was established, it was 99·9.

THE Pan-American Congress of Rural Hygiene organized by the Government of Mexico and the International Congress of Otorhinolaryngology which were to have been held in 1940 have been postponed indefinitely owing to the War.

WE have received the first annual report of the Council of the Institute of Medical and Veterinary Science, Adelaide, South Australia. New laboratories of the Institute have recently been opened, of which an illustration is given. The Institute provides for the Adelaide Hospital, and for practitioners resident in the district, services in pathology, bacteriology and biochemistry, as well as work in veterinary pathology. A summary is given of the research work conducted by the staff of the Institute. This Institute was described by Sir Charles Martin in NATURE of August 26, p. 392.

Chronica Botanica, the international botanical journal published under the editorship of Dr. Frans Verdoorn, is to appear weekly from January 1940. This journal is unique among scientific journals, and contains digests, correspondence, quotations, comments on international affairs, news of institutions, experiment stations, gardens, societies, etc., personal notes and news, reviews, etc. The annual subscription will be 15 guilders, including postage. Further information can be obtained from *Chronica Botanica*, P.O. Box 8, Leyden, Holland.

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. They cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

IN THE PRESENT CIRCUMSTANCES, PROOFS OF "LETTERS" WILL NOT BE SUBMITTED TO CORRESPONDENTS OUTSIDE GREAT BRITAIN.

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 1094. CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Scientific and Technical Literature and Information

I HAVE read with interest the editorial in NATURE of November 25, 1939, concerning the need for a centre of documentation with the purpose of supplying original papers to scientific institutions and to libraries. Further aims of such a centre might be to prepare abstracts and translations, to set up complete documentation indexes and to take the role of a link between research institutes.

The difficulties pointed out in the editorial have been met with in France, too. I have the pleasure of announcing that a body similar to that suggested in NATURE has just been brought into existence in this country, under the auspices of the "Centre National de la Recherche Scientifique" which is an autonomous Department of the Ministère de l'Education Nationale. This "Service de Documentation" undertakes the following tasks:

(1) to receive and to keep all scientific periodicals which are considered to be of importance for complete documentation covering the fields of chemistry, physics, applied chemistry, technical physics, biochemistry, and some branches of biology;

(2) to abstract these periodicals in the form of very short summaries including title, reference, and a few lines intended to locate accurately the contents of each paper;

(3) to edit and to publish a printed bulletin, to appear twice a month, and to supply it to the institutions concerned;

(4) to reproduce on microfilm single original papers wanted by laboratories and research institutes; to supply positive copies of such microfilms; to keep the negatives;

(5) to establish several card indexes of the abstracts, by authors, by subject matter and so forth, so as to facilitate quick compilation of complete dossiers on a given subject, whenever asked for;

(6) on request, to supply translations of papers published in unusual languages.

This "Service de Documentation" was created on November 16, 1939, and it is hoped that the first bulletin may appear within a few weeks. The Service is to act in close collaboration with French scientific societies, especially those which have been publishing scientific abstracts.

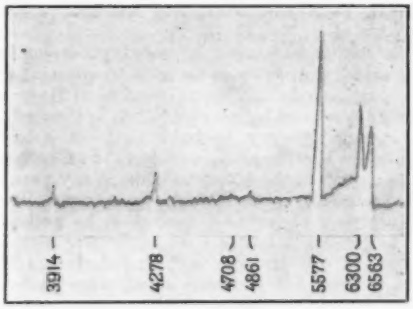
I shall be very glad to get in touch with people dealing with the same problem in Great Britain, in view of possible collaboration in this matter between our two allied countries.

P. AUGER.
(Directeur.)

Service de Documentation
du Centre National de la Recherche Scientifique,
18 rue Pierre Curie, Paris, V^e.

Hydrogen Showers in the Auroral Region

PREVIOUS investigations have shown that the hydrogen lines are usually absent from spectrograms of the auroral luminescence. Even when the stronger lines and bands are much over-exposed and also very faint lines appear, there may still be no trace of the H-lines visible on the spectrogram[1,2,3,4]. This does not mean, however, that hydrogen may not occasionally appear in these regions. On the contrary, some years ago I gave, for the luminous night clouds, an explanation[3] based on the assumption that showers of hydrogen, coming from the sun, entered into the atmosphere and combined with oxygen, for example, in the atomic or ozone state, to form water vapour. At the altitude of the luminous night clouds (80 km.), the atmospheric pressure might be sufficiently great for the water vapour to condense and produce clouds of ice needles.



During an auroral display on October 18 this year, we obtained at Oslo auroral spectrograms indicating the existence of such hydrogen showers. In the region of long waves, two spectrograms from auroral arcs showed the green line (5577) and the red one (6300) with considerable density. The 1st positive group, however, was scarcely visible; but far in the red end and well separated from the line (6300), a strong line appeared with a wave-length (6560) which within the limit of error coincides with H_α (6563). Now this coincidence might be accidental, but on the first of our spectrograms (exposure from 19.15–20.13 M.E.T.) where the spectrum appeared with greatest density, another line appeared for which we found the wave-length 4860, which within the limit of error coincides with H_β (4861).

This line, which is usually absent in the auroral spectrum, now appeared with a density twice that of the negative band 4708 and about two thirds that of the strong band 4278. A spectrophotogram of the spectrum is shown in the accompanying reproduction.

The simultaneous great enhancement of two lines, one of which coincides with H_α, the other with H_β, can scarcely be accidental, and our spectrogram thus would show that *occasionally considerable quantities of hydrogen are present in the auroral region.*

The fact that the hydrogen concentration usually is too small to give detectable lines would show that *the occurrence of strong hydrogen lines must be due to showers of hydrogen or to a kind of 'hydrogen radiation' occasionally coming from the sun.* The hydrogen is then removed from the auroral region through the formation of water vapour and condensations, which may appear as luminous night clouds.

L. VEGARD.

Physical Institute,
Oslo.
Nov. 20.

[1] Vegard, L., *Phil. Mag.*, **46**, 195 (1923); *Z. Phys.*, **16**, 367 (1923).
[2] Vegard, L., *Geof. Publ.*, **9**, No. 11 (1932).
[3] Vegard, L., *Geof. Publ.*, **10**, No. 4 (1933).
[4] Vegard, L., and Harang, L., *Geof. Publ.*, **11**, No. 15 (1936).

Origin of the λ 4932 Emission in the Spectra of Novæ

MESSRS. J. DUFAY AND M. BLOCH[1] have recently discussed the presence of a faint emission band at about 4932 A. in the spectra of Nova Herculis (1934) and of Nova Aquilæ (1918), and have suggested that the radiation is to be identified with the forbidden $^3P_0-{}^1D$ transition of O (III), the companion of the N_1 and N_2 lines at 5007 and 4959 A. respectively. This assignment, as was mentioned by Dufay and Bloch, was made by Bowen and Wyse in the spectra of N.G.C. 6572 and 7027, and the line was later observed also in N.G.C. 7662[2].

While the identification is probably correct in the nebulæ cited, it appears to be open to question in the novæ, particularly in Nova Aquilæ (1918). The maximum observed by me at 4932 A. in the spectrum of this nova is very probably only a subsidiary maximum in the broad N_2 emission band, centred at 4959 A.; such is the interpretation in my paper[3], to which Dufay and Bloch make reference. The relatively strong continuous spectrum, as well as the great width of the bands themselves (approximately 50 A.), tends to obliterate the faint radiations. Therefore if a *bona fide* emission band were present at 4932 A., it would probably have to be at least 1/10 or 1/20 as bright as N_2 in order to be detected, and thus it could not be the $^3P_0-{}^1D$ emission, which is much fainter both by prediction and by observation in the nebulæ.

The case for Nova Herculis (1934) is not so clear-cut. The Lick Observatory spectrograms of 1935 and 1936 confirm the observation of Dufay and Bloch of a faint emission at 4932 A. The emission appears to be several times stronger with reference to N_1 and N_2 than in the nebulæ, thus suggesting some other identification. The difference, however, may possibly be attributed to the differing contrasts of the two emulsions involved. Another approach to the question consists in examining the constancy or variability, in Nova Herculis, of the intensity ratio, I_{4932}/I_{4959}, which should be an atomic constant for O III. Two Lick Observatory spectrograms, dated September 26, 1935, and May 1, 1937, both record the N_2 emission as of about equal density, the image on the latter plate being slightly denser than on the former. The 4932 A. line appears definitely on the former plate (density about 0·8), while on the latter plate it is absent. Inasmuch as the two spectrograms have been made on the same type of emulsion and have been developed in the same way, and further, since both plates are capable of showing the lines resolved, the inference is that the 4932 A. line faded in the interval, with respect to N_2, by a factor of at least 10, and that it is therefore not chiefly attributable to O III.

Perhaps this observation should not be taken at its face value, in view of the possibility of solarization of the strong lines on one or both of the plates, or other spurious photographic effects. In any event, there appears to be room for doubt regarding the assignment of the nova emission at 4932 A. to O III.

A. B. WYSE.

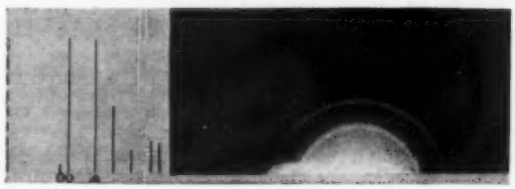
Lick Observatory,
Mount Hamilton,
California.
Nov. 20.

[1] NATURE, **144**, 593 (1939).
[2] *Lick Obs. Bull.*, **19**, 1 (1939).
[3] *Publ. Lick Obs.*, **14**, Part 3 (1939).

Electron Diffraction Examination of Oxide Films on Light Metals

WHILE iron rusts quite easily in air, such baser metals as aluminium, magnesium, zinc, etc., do not manifest this tendency and retain their metallic lustre for a considerable length of time. This commonplace fact is interesting but requires experimental study for a full understanding. For a study of metal surfaces as in these cases, the method of electron diffraction is most powerful.

MAGNESIUM AT ROOM TEMPERATURE.



MAGNESIUM AT 400° C.
□ INDICATES THE EXISTENCE OF Mg. ○ AND △ INDICATE THE EXISTENCE OF MgO.

Electron diffraction photographs of magnesium specimens, prepared by polishing the surface with a coarse sandpaper, were taken after exposing them to air at room temperature, at 200° C., at 300° C., and at 400° C. Of the two photographs reproduced, one is that of the specimen at room temperature and the other is that of the specimen heated at 400° C. In the graphs, the horizontal distance from the origin is the radius of the ring while the length of the lines is a measure of the intensity by visual estimation.

The most intense ring of MgO is found, though faint, in the pattern of the specimen left in the air at room temperature; likewise, the most intense ring of Mg is seen faintly in the pattern of the specimen heated at 400° C. It has therefore been concluded that magnesium metal is masked with a thin film of magnesium oxide (MgO) even at room temperature, and the film is still quite thin even after heating at 400° C. Such a thin film, 10 A. or so in thickness, protects the metal and keeps it lustrous for a long time.

Although it is very difficult to obtain the patterns of the aluminium oxides by the reflection method[1], we succeeded in producing them by making deep ditches on the metal. Precisely as in the case of magnesium, it was possible to verify that the surface of aluminium at room temperature is covered with a film of γ-Al_2O_3, while the specimen heated at 500° C. is covered with a film of α-Al_2O_3.

With beryllium left exposed at room temperature, the pattern obtained from the surface precludes the possibility of even a trace of rings belonging to the oxide BeO.

Full details of these experiments will be published in the *Scientific Papers* of our Institute.

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Institute of Physical and
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[1] Preston, G. D., and Bircumshaw, L. L., *Phil. Mag.*, **22**, 654 (1936).

Decomposition of Hydrogen Peroxide by Catalase

THAT the catalytic decomposition of hydrogen peroxide by catalase requires the presence of molecular oxygen was demonstrated by a number of manometric experiments previously described[1]. Being, however, well aware of certain difficulties in this kind of work, we have given a detailed account of our methods so that our experiments could easily be repeated.

The failure by Weiss and Weil-Malherbe[2] to confirm our results can only be ascribed to some defects in their experimental procedure and to the fact that they have not closely followed the recommendations put forward in our paper.

Our criticism[3] of experiments with luminescent bacteria was not solely due to the purely qualitative character of this work[4], but mainly to the fact that under the conditions of these experiments even a 90 per cent inhibition of catalase could not be detected.

That the curves of inhibition shown in our paper are not of autocatalytic type can be explained by the instability of pure catalase at high dilutions (0·0005 mgm. per flask) used in our experiments.

Moreover, our manometric experiments, which we have repeated several times since the publication of our paper, are in complete agreement with the results we have obtained from the study of catalase inhibited by sodium azide or by hydroxylamine[5]. Both these inhibitors combine reversibly with catalase giving well-defined compounds.

It is, however, important to remember that free catalase and azide- or hydroxylamine-catalase are very similar compounds displaying the same general properties. Thus, their iron is in the trivalent state, they show a typical methæmoglobin-like absorption spectrum, they share the remarkable property of not being reduced by a powerful reducer like sodium hyposulphite and they react with hydrogen peroxide.

While the reaction of free catalase with hydrogen peroxide is extremely rapid and therefore inaccessible to spectroscopic study, that of azide- or hydroxylamine-catalase is on the contrary slow and can easily be followed spectroscopically. The study of this reaction clearly shows that azide-catalase treated with hydrogen peroxide undergoes reduction which is marked by a distinct change in its colour and its absorption spectrum and by the appearance of the property, shared with other divalent haematin compounds, of combining with carbon monoxide. On the other hand, the reduced azide-catalase cannot be oxidized by hydrogen peroxide although it can be oxidized by molecular oxygen, which in this reaction is reduced not to hydrogen peroxide but to water. In this respect catalase, unlike many autoxidizable compounds, resembles cytochrome oxidase and probably polyphenol oxidase which on reoxidation reduce oxygen to water. Azide and hydroxylamine inhibit the activity of catalase only because they slow down the reoxidation of ferrous catalase by oxygen.

Our conclusion that catalatic decomposition of hydrogen peroxide is brought about by a constant reduction of catalase iron by hydrogen peroxide and its reoxidation by molecular oxygen is therefore well supported by two independent experimental approaches to the problem, namely the manometric and spectroscopic studies of the enzyme. The importance of specific inhibitors and of spectroscopic methods in the study of enzymes is now universally recognized and can scarcely be over-estimated. In very few cases, however, can the importance of these methods be so clearly demonstrated as in the study of catalase.

Considering that a pure or even crystalline catalase showing strong colour and absorption spectrum can be so easily prepared, the workers[2] interested in the intimate mechanism of catalatic activity should attempt to prepare such an enzyme and to acquire thus a first-hand knowledge of its properties.

The fact that the results of our experiments do not agree with certain theoretical considerations[3,6] concerning the possible mechanism of catalytic activity of this enzyme suggests only that these considerations require some revision.

D. KEILIN.
E. F. HARTREE.

Molteno Institute,
University,
Cambridge.
Dec. 13.

[1] Keilin, D., and Hartree, E. F., *Proc. Roy. Soc.*, B, **124**, 397 (1938).
[2] Weiss, J., and Weil-Malherbe, H., NATURE, **144**, 866 (1939).
[3] Keilin, D., and Hartree, E. F., NATURE, **144**, 787 (1939).
[4] Johnson, F. H., and van Schouvenburg, NATURE, **144**, 634 (1939).
[5] Keilin, D., and Hartree, E. F., *Proc. Roy. Soc.*, B, **121**, 173 (1936).
[6] Weiss, J., *J. Phys. Chem.*, **41**, 1107 (1937).

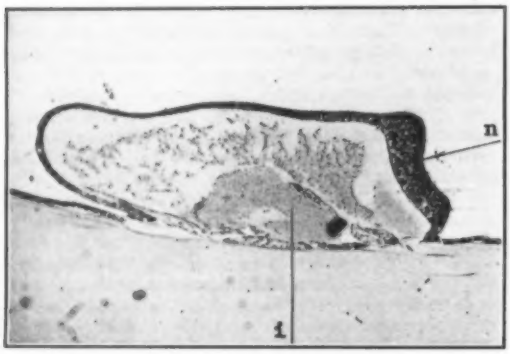
Evocation in the Chick

WORK on the evocation of neural tissue in vertebrate embryos by chemically prepared substances has hitherto been confined to the Amphibia[1]. But since in the induction of neural tissue in general the chick has shown considerable similarities to the newt, especially in the inducing activity of its organizer when coagulated[2], and in the inducing activity of fully differentiated tissues[3], there was reason to

believe that it would respond in a similar way to chemicals. This was not tested, however, owing to a technical difficulty: any implant of dead material becomes surrounded by mesenchyme, and consequently isolated from the reactive ectoderm[3].

This difficulty has recently been surmounted. The substance to be tested, dispersed in a piece of coagulated egg albumen by Waddington's method[4], is inserted between the endoderm and ectoderm (presumptive epidermis) in the antero-lateral region of the area pellucida of a blastoderm in the early primitive streak stage. This region of the area pellucida, together with the adjacent area opaca, is then isolated, no part of the primitive streak being included with it, and the isolate is grown *in vitro* by Waddington's method[5]. At the time of isolation no mesoderm is present in this part of the blastoderm, and since the primitive streak is eliminated none afterwards appears in it.

Controls with no implant formed no neural tissue, and only very occasionally a slight epidermal thickening, provided the antero-medial region of the area pellucida was not included. Controls of albumen alone commonly showed a slight epidermal thickening.



EVOCATION BY SODIUM-1 : 2 : 5 : 6-DIBENZANTHRACENE-ENDO-α-β-SUCCINATE.
i, IMPLANT; *n*, NEURAL PLATE.

All the chemical substances tested on the chick had previously been shown to be active in the Amphibia[4]. One satisfactory evocation of a neural plate was obtained with sodium-1 : 2 : 5 : 6-dibenzanthracene-endo-α-β-succinate (see figure). The most usual result with this substance, however, was an extension in area of the ectoderm, together with a non-neural thickening; the latter varied from a histologically epidermal thickening little greater than those found in the controls, to a large thickening histologically like early neural tissue. One induction, in which, however, the origin of the ectoderm is not certainly established, was obtained with 1 : 2 : 5 : 6-dibenzanthracene, which is carcinogenetic in the adult fowl[6]. Styryl 430, very active in Amphibia[4], was only slightly more active than plain albumen in the chick. 1 : 2-dihydroxy-1 : 2-di-α-naphthylacenaphthene was no more active than plain albumen. A probably impure specimen of naphthalene, of moderate activity in Amphibia[4], was the most active substance tried: three good evocations were obtained with it. Impure glycogen, active in Amphibia, produced no neural tissue, but a very marked proliferation of epidermal cells.

Presumptive epidermis, coagulated by heat or acetone, was also tested. One good evocation, and one almost positive, were obtained (both acetone coagulation), and various degrees of thickening were produced in other specimens. As in Amphibia, therefore[7], the presumptive epidermis, which is the indicator of evocating activity, can itself be made to become an active evocator.

The conclusion from these results is that the process of evocation is fundamentally similar in the chick and in the newt, in that it can be produced by chemicals and by coagulated presumptive epidermis. But the chick is rather refractory material, and there are clear indications that the degree of its reactivity to individual chemicals is different from the newt's.

M. ABERCROMBIE.
Strangeways Research Laboratory,
Cambridge.
Nov. 23.

[1] Waddington, C. H., and Needham, D. M., *Proc. Roy. Soc.*, B, **117**, 310 (1935); Waddington, C. H., *Proc. Roy. Soc.*, B, **125**, 366 (1938); Fischer, F. G., Wehmeier, E., Lehmann, H., Jühling, L., and Hultsch, K., *Ber. dtsch. chem. Ges.*, **68**, 1196 (1935); Barth, L. G., *Physiol. Zool.*, **12**, 22 (1939).
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[4] Waddington, C. H., *Proc. Roy. Soc.*, B, **125**, 365 (1938).
[5] Waddington, C. H., *Phil. Trans. Roy. Soc.*, B, **221**, 179 (1932).
[6] Burrows, H., *Amer. J. Cancer*, **17**, 1 (1933); Peacock, P. B., *J. Path. Bact.*, **36**, 141 (1933).
[7] Holtfreter, J., *Arch. Entwmech.*, **128**, 584 (1933).

Growth-stimulating Effects of Extracts of Normal Adult Tissues and Tumours

IN investigations on the physiology of neoplastic growth, the conceptions are often encountered that the malignant cell has an unusually high growth capacity as compared with the normal cell, and that neoplastic tissue is especially rich in growth-promoting factors.

Recent work has shown clearly that the first notion is untenable. Studies on tumour tissue growing *in vitro* have proved that the growth capacity of neoplastic cells is not greater than that of normal embryonic cells[1]. Furthermore, as we have recently shown, cells from adult organisms grow as well *in vitro* as those of embryos[2]. These facts make it clear that the distinction between normal and neoplastic cells is not to be found in any unusual growth potentiality of the latter. So long as growth-promoting substances are present, cells outside the body behave alike whether they originate from embryonic, normal adult, or tumour tissue.

The conception that neoplastic growth is connected with the presence of a large amount of growth-stimulating factors in tumour tissues would appear to have been confirmed by the experiments of Carrel and Burrows[3], Carrel[4,5], Mottram[6], Bisceglie[7] and Drew[8], all of whom demonstrated the marked cell growth-stimulating action of extracts of tumour tissue. However, since recent experiments[9,10] have shown that extracts of normal adult tissue are also powerful growth stimulators, we thought it important to determine whether the stimulating effect of tumours is in reality exceptionally high, and whether it is greater than that of normal tissue.

We compared quantitatively the growth-stimulating effect of extracts of tumour tissue with those of normal adult tissue extracts. Cardiac and smooth muscle of chickens were used in the preparation of

extracts of normal adult tissue, Rous sarcoma for tumour extracts. Young tumours, about olive size, without visible necrosis, were selected. The finely minced normal and malignant tissues were each extracted in four times their volume of Tyrode. The resulting extracts were used in their original concentration. The stimulating action of extracts was tested quantitatively on fibroblast cultures grown in Carrel flasks, prepared according to the standard technique. The growth-rate of the colonies was measured daily, according to the method of Ebeling, over a period of seven days. The medium was not changed during this period. The fibroblast colonies in both cases were uniform and regular in structure but the cells growing in tumour extracts were somewhat more granulated.

Our experiments showed that the growth-activating effect of the sarcoma extract is certainly not greater, but on the average rather weaker, than that of adult muscle extracts. The mean for the growth-activating effects of the tumour extracts is about 75 per cent of the latter.

The peculiar behaviour of malignant cells in the organism is, therefore, obviously not to be found in any unusually high growth capacity of these cells, or in any unusually high amount of growth-promoting substances in neoplastic tissue. In order to explain the autonomous growth of the malignant cell it is necessary to postulate some intrinsic change in the mechanism which in the body normally controls and holds in check this *ever-present* growth potentiality.

Details of our experiments will appear elsewhere.

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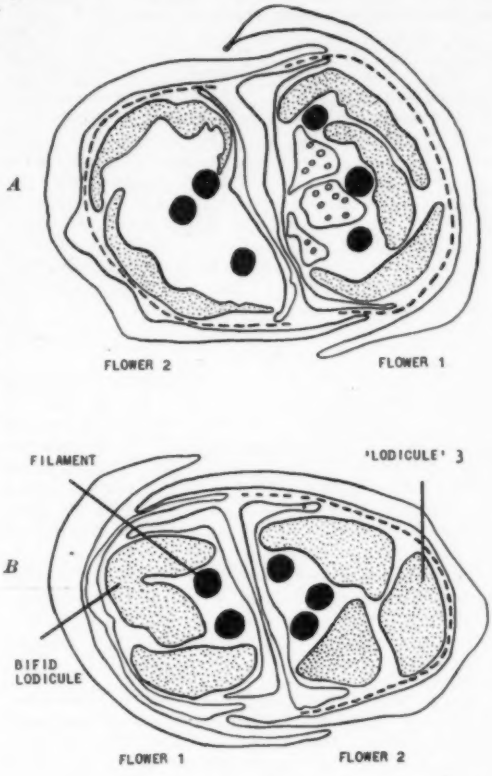
Stamen Lodicules in Maize

AMONG some maize plants (Sutton's White Horse Tooth) originally planted in connexion with other work, there appeared one which bore anomalous male flowers the morphology of which may be worth recording. In the tassel of this plant, in a considerable number of cases, the lower flowers in each spikelet possessed only two stamens; sections showed that often both flowers in the spikelet were abnormal.

A illustrates a spikelet in which flower 1 has three 'lodicules' and three stamens, while flower 2 is normal. *B* shows flower 1 with two 'lodicules' (one of which is bifid at the tip) and two stamens, while flower 2 has three 'lodicules' and three stamens. In both flower *A*1 and *B*2 the 'extra lodicule' is united with the anterior stamen towards the base. In flower *B*1 the anterior part of the bifid lodicule would seem to represent the missing anterior stamen.

Thus the 'extra' lodicule does not seem to represent the 'missing third lodicule' of the grass flower but appears to be a replacement of or an outgrowth from the anterior stamen, and would come under the category of what Arber[1] has called stamen-lodicules and recorded for the bamboo Cephalostachyum, where it is also the front outer stamen which most frequently becomes lodicular.



Small quantities of material, so far as available, will gladly be sent to anyone desiring it on receipt of stamps for postage.

Thanks are due to Dr. A. Arber, of Cambridge, and to Prof. P. Weatherwax, of Indiana, for their kindness in examining and commenting on the material and slides.

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Effect of Suint on Sheep Dips

EXPERIMENTS carried out in this Department have shown that the addition of wetting agents to an arsenic dip results in a decreased retention of arsenic in the fleece; the wetting agent causes the dip to penetrate the fleece more readily, but it also facilitates drainage from the fleece after immersion. Suint, the water-soluble matter in sheep's wool, is well known

to have good wetting properties, and this material must accumulate in the bath when large numbers of sheep are dipped. In order to determine what effect suint has, observations were made at a routine dipping of 264 Welsh yearlings at the College Farm. Samples of the dip were collected at the beginning and end of the dipping; also, observations were made on the first and last three sheep through the dip, the wool samples being taken from the back. The accompanying table gives the results.

	Initial dip	Final dip
% soluble As_2O_3	0·118	0·125
% soluble matter	0·19	2·66
Surface tension: dynes/cm.	73·0	43·3
	First 3 sheep	Last 3 sheep
Duration of protection against experimental myiasis (weeks)	3	2
% soluble As_2O_3 in wool at base of fleece 6 days after dipping	0·44, 0·51, 0·58	0·12, 0·23, 0·25
% decrease in soluble As_2O_3 content of whole staple from 6th to 26th day after dipping	23	57

It will be seen that there is a remarkable difference between the sheep dipped at the beginning and at the end; this result is not due to the dip becoming weaker but to the extraneous material introduced during dipping. The change in the physical properties of the dipping fluid was mainly due to suint; this material contains a high proportion of fatty acids and markedly lowers the surface tension of water. Shortly after dipping, the arsenic content of the fleece was considerably lower in the sheep dipped last as compared with those dipped first; also, the arsenic disappeared from the fleece more rapidly and poorer protection was afforded against experimental infestation with sheep maggots (by the method of MacLeod[1]).

It has long been realized by farmers that the dipping fluid becomes less effective in protecting sheep against maggot flies after a large number of sheep have been through the bath. This has usually been ascribed to contamination of the dip with dung and urine, materials which attract the fly. The present results suggest that the presence of suint in the bath may be of more importance, since this changes the physical properties of the fluid and results in a smaller and less stable deposit of poison in the fleece. Further work is in progress to find methods of preventing the deleterious effects of suint in the dipping bath.

This dipping at the College Farm was carried out in the spring with sheep in almost full fleece, but the animals were small and in poor condition after a hard winter. Higher concentrations of suint probably occur at larger dippings, especially of lowland sheep in good condition.

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Points from Foregoing Letters

IN spectrophotograms of the auroral spectrum taken on October 18, L. Vegard has observed great enhancement of two lines coinciding with the two well-known lines of the hydrogen spectrum. This indicates the occasional presence of considerable quantities of hydrogen in the auroral region, which are due possibly to 'hydrogen showers' from the sun.

A. B. Wyse discusses the interpretation of a faint band at about 4932 A. in the spectra of Nova Herculis (1934) and of Nova Aquilæ (1918). Radiation from nebulæ in this region is probably due to oxygen. On the other hand, that from novæ is believed to be due to nitrogen.

I. Iitaka and S. Yamaguchi submit electron diffraction photographs of specimens of magnesium at room temperature and at 400° C. These indicate that magnesium after polishing with glass paper is covered by a thin film of oxide even at room temperature. A film of oxide also appears to exist on aluminium, but no trace of a film was found on beryllium.

M. Abercrombie has shown that evocation of neural tissue by chemical substances, including carcinogens, is possible in the chick embryo. Coagulated presumptive epidermis is also an evocator. The process of evocation in the chick is fundamentally similar to that in the newt, though the degree of reactivity of the former to individual chemicals is different from the newt's.

R. S. Hoffman, E. Tenenbaum and L. Doljanski find that the activating effect of Rous sarcoma extracts on the growth of fibroblast cultures *in vitro* is not greater than that of extracts of normal adult tissue. The significance of the facts that neoplastic tissue has neither an unusually high growth-capacity nor an unusual wealth of growth-promoting agent as compared to normal tissue, and their bearing on the behaviour of malignant cells in the organism, is discussed.

Anomalous male flowers of maize (Sutton's White Horse Tooth) are described and illustrated by B. C. Sharman, where the anterior stamen is replaced by or arising in association with a third 'lodicule', akin to the stamen-lodicules described by Arber for Cephalostachyum.

Suint, the water-soluble material in sheep's wool, has good wetting properties. Observations by R. P. Hobson suggest that the accumulation of suint in the bath during dipping has a pronounced effect on the physical properties of arsenic dips; this results in a lower content of arsenic in the fleece and poorer protection against infestation by sheep maggots. Work is in progress with the view of finding methods of preventing the deleterious effects of suint in the dipping bath.

RESEARCH ITEMS

India and Crete

A SIMILARITY between pottery found at Maniyar Math in Rajgir, southern India, and finds in Crete is suggested by J. G. Aravamuthan in *Man* of December 1939. The Indian pottery vessels are attributable to an age roughly anterior to the Christian era, and are said to bear spouts varying in number from four to twenty, or even thirty-four in one instance. On the spouts were designs described as "serpents, sieves, animals, etc.". Associated with the finds were terra-cotta images of hooded snakes and a large stone slab containing a number of hooded figures. Mani Naga was the protector and rain-giver of Rajagirha. The name of the god implies association with the serpent. Finds in Crete resembling the Indian vessels appear to be adaptations of drain-pipes, on which the representation of snakes moulded in relief in certain instances points to their use as places of refuge for snakes, while cups on the outside might be used to supply them with milk or other refreshment. In another type a snake is coiled around a naturally formed honeycomb. In still another a snake peeps into the mouth of the jug. Several show snakes approaching or peeping into a cup. The earliest known of this class is a vessel in the form of a female with snakes coiling round the neck. The Cretan vessels are thus multifarious in form and have evolved into a number of varieties. The Rajgir spouted and perforated vessels embody features found in one or other of these varieties. The link between India and Crete seems evident, but beyond relation to a snake cult and a necessary connexion with bringing down rain, the purpose is obscure.

Volcanic Action in Minoan Crete

SIR ARTHUR EVANS has suggested that the catastrophes which archæological research has revealed overwhelmed the Cretan palaces of the Minoan civilization were caused by earthquakes. An alternative theory that they were due to volcanic action from the island of Thera similar to the explosion of Krakatau in 1883, is put forward by Sp. Marinatos in *Antiquity* of December. The ground for this suggestion is the result of a recent excavation on the site of Amnisos, a settlement on the coast of Crete, destroyed at the same time as Nirou Khani, Malia, Gournia, Zakro, and perhaps others. At Amnisos one of the buildings, quite near the sea, at the deeper levels was buried under a mass of pumice stone and sand, and a square pit inside the building was full of pumice stone. A reconstruction of the catastrophe suggests that sea waves broke over the building and carried it away almost to its foundations. It was abandoned and later the north breezes brought the pumice stone from the volcano. This receives support from the fact that the pieces of pumice were all small, rounded and polished like pebbles. At the "Villa of the Frescoes" higher up the beach there was no pumice, but the walls had collapsed in a remarkable fashion due to some tremendous natural force—surely the waves after an eruption. It has been pointed out that much additional support from excavation on selected sites would be necessary to convince archæologists generally of the truth of this explanation.

Toxicity of Indene

THE destructive action of heavy coal tar naphtha on the bed bug appears to depend largely on the presence of unsaturated constituents, especially indene (C_9H_8). The high price of this hydrocarbon prohibits its use on a large scale, but the indene content of naphtha can be increased without unduly raising the cost, and information concerning the toxicity of indene to man is therefore desirable. G. R. Cameron and Cecile R. Doniger have investigated its toxic effects on rats, mice and guinea pigs, and find that in high concentration or on administration of large amounts it causes necrosis of organs such as the liver and spleen. Indene cannot therefore be regarded as a highly noxious agent; but the authors consider that a limit should be imposed on the indene content of such insecticides as heavy coal tar naphtha (*J. Path. and Bact.*, **49**, No. 3, 529).

Control of the Potato Root Eelworm

IN experiments carried out on small field plots at the Albert Agricultural College, Glasnevin, a very promising degree of control of the potato root eelworm, *Heterodera schachtii*, has been obtained by J. Carroll using trap-cropping with potatoes. Sprouted potatoes were planted in plots of 'potato sick' land on April 1, 1938. Five weeks after planting date the plants, and tubers from which they grew, were removed from the soil. No effort was made to remove the roots of the plants as this was found to be unnecessary. After removal of the trap crop plants, turnips were sown in the plots. In 1939 very good crops of potatoes, showing no obvious overground symptoms of eelworm infestation, were produced on the plots which had been trap-cropped in 1938. Control plots exhibited typical severe symptoms of eelworm infestation. Further experiments demonstrated that the removal of two successive trap crops in one season did not produce markedly better results than the removal of one trap crop. Experiments are proceeding on a larger field scale.

Trisomic Nicotiana

T. H. Goodspeed and P. Avery (*J. Gen.*, **38**, 381–458; 1939) have given an account of the trisomic and other types found in *Nicotiana sylvestris*. 164 trisomic plants including eleven different primaries, 21 tetrasomics, 45 double trisomics, 13 triple trisomics and 30 variant trisomics have been found in about 9,000 plants. These have arisen from irradiation by X-rays, from plants homozygous for a gene causing asynapsis, or from the cross triploid × diploid. The morphological appearance of the trisomics are described, while the presence of an extra fragment also has a characteristic effect. Transmission of the primary trisomics through pollen and ovules is relatively high, but varies with the particular trisomic. The chromosomes of *Nicotiana sylvestris* and their relationship to nucleolus formation are described. The somatic expression of diploid *N. sylvestris* represents an interaction of the various growth rates of organs and tissues which differentiate the primary trisomics.

Breakdown in Stored Plums

INTERNAL breakdown is common in plums stored for protracted periods at low temperatures. The variety Monarch, which is particularly susceptible to this type of trouble, has been studied at various storage temperatures by W. H. Smith (*J. Pom. and Hort. Sci.*, **17**, 284; 1939). The fruit, which was 'pre-climacteric' at the time of picking, was divided into 'more mature' and 'less mature' batches and stored at seven temperatures between 65° F. and 31° F. Samples were removed from store at intervals of seven days and cut open for examination. Greater maturity at picking had the effect of advancing the time of the first appearance and maximum development of physiological breakdown. The relative amounts of breakdown at different temperatures were unaffected by differences of maturity. Maximum breakdown after 14–21 days of storage occurred at medium temperatures. After longer periods higher maxima occurred at progressively lower temperatures. The minimum percentage of breakdown always occurred at 34° F., the amount rising rapidly at both lower and higher temperatures. Two distinct types of injury, appearing as 'internal browning' and 'jellying', were recognized. At 45° F. and above, the plums are susceptible only to jellying, this type of injury falling to nil with rise of temperature. At 34° F. and below, they are susceptible only to browning, susceptibility increasing rapidly with reduction of temperature. Between these temperatures both types of injury may occur in the same plum or different plums in the same batch.

Rose Propagation

ROSE cuttings generally root with considerable difficulty, yet little work on propagation by stem cuttings has hitherto been undertaken. Dorothy Brandon (*J. Pom. and Hort. Sci.*, **17**, 233; 1939) has studied the differences in rooting properties of a large number of members of the genus Rosa and the effects of various treatments to encourage rooting. The suggestion that high starch content is correlated with easy rooting has been likewise examined. Hardwood cuttings of twenty-six species and varieties were taken at intervals throughout the winter, the highest percentage of rooting being obtained in the period October-December. June was found to be the best time for inserting softwood cuttings. The effects of treatment with ethylene chlorhydrin, thio-urea, sodium nitrate, glucose, and indolyl acetic acid were tried. The two latter increased rooting slightly whilst the two former substances depressed it. No treatment was found to give results sufficiently beneficial to be of practical value. Fluctuations in starch content during the season varied according to species and variety, botanically related species and varieties falling into the same groups. Starch persisted throughout the winter in some species and disappeared in others. No correlation was found to exist between the starch content of cuttings and facility of rooting.

Kernel Smut of Sorghum

A SMUT disease of the Sorghum plant causes damage in Egypt, but Dr. A. F. El-Helaly has recently shown that it can be controlled at negligible cost by treatment of the seed with an appropriate fungicide ("Studies on the Control of Kernel Smut of Sorghum". Min. Agric. Egypt, Tech. and Sci. Service Bull. 233. Govt. Press, Bulâq, Cairo, 1939. P.T.3). The disease is caused by the fungus *Sphacelotheca Sorghi*, and is usually most severe upon early sowings of the host crop. The range of temperature within which both grain and fungus spores will germinate is wide in the months of April and May, but becomes narrow in June and July, being so limited in the latter month that the disease is rare. 'Herati' sowing, where the soil has a considerable water content when the seed is sown, favours the parasite more than the 'Afir' method of sowing in dry soil which is irrigated later. Control was obtained by treating the seed with organic mercury germicides, either 2·5 or 5 gm. of agrosan *G* per kilogram of seed, or a 1–2 per cent solution of uspulun or germisan. An interesting effect was demonstrated with sulphur and copper carbonate, the toxic effect of which was increased by using soil filtrate in place of distilled water in the preparation of fungicidal liquid.

Composition of Ancient Greek Bronze Coins

A LONG monograph by E. R. Caley on "The Composition of Ancient Greek Bronze Coins" contains a large number of analyses and four plates of microphotographs (*Mem. Amer. Phil. Soc.*, **11**). One interesting general result of the study is the variation in the proportion of tin and lead in the bronzes, the amount of lead increasing in the more debased coinage of later periods. The author discusses the probable causes for this varying ratio. Re-melting old coins with lead was one cause; others were the technical requirements of minting, adverse economic conditions, disruption of trade by wars, and scarcity of tin. The study is of considerable archæological and historical, as well as chemical interest. It is published at 2.50 dollars by the American Philosophical Society, Philadelphia.

Stereochemistry of Complex Inorganic Compounds

THE reaction of dichloro-diethylenediamine cobaltic chloride, $[Coen_2Cl_2]Cl$, with potassium and silver carbonates was the first example of the Walden inversion in the field of inorganic complex compounds, the *l*-form being converted into the *d*-form of the carbonate compound, $[Coen_2CO_3]Cl$, in the case of potassium carbonate, and the *d*- or *l*-forms of $[Coen_2CO_3]_4CO_3$ in the case of silver carbonate. J. C. Bailar and J. P. McReynolds (*J. Amer. Chem. Soc.*, **61**, 3199; 1939) have now prepared two diastereoisomeric forms of the propylenediamine compound $[Copn_2CO_3]_2CO_3$ by a Walden inversion method. Rotatory dispersion curves for these and for *cis*-dichloro-di-*l*-propylene-diamine cobaltic carbonate, by comparison with the curves for the analogous diethylenediamine series, lead to a determination of which of the two carbonate forms is obtained by an inversion about the central cobalt atom in the latter case. It is further suggested that the mechanism of the production of the two forms of the carbonato complex is as follows: The non-inverted form is produced through the preliminary displacement of the Cl ions in the *cis*-dichloro-di-*l*-propylenediamine cobaltic chloride by water molecules, followed by displacement of H_2O by CO_3, whilst the inverted form is produced by direct substitution of CO_3 for Cl within the complex. Either form could be produced with silver carbonate alone or potassium carbonate alone by varying the experimental conditions, and the inverted form of carbonato diethylenediamine cobaltic carbonate was produced, for the first time, by using potassium carbonate.

RECENT RESEARCHES ON EARLY MAN IN CHINA. II

'MODERN MAN' IN EASTERN ASIA[1]

"THE Upper Cave" of Choukoutien, discovered in 1930, and excavated in 1933 by Mr. W. C. Pei, is situated at the top of the hill about 175 m. above sea-level, opening to the north and north-east side of the hill. It represents a dissolution cavity in the original limestone massif and is completely separated from the Sinanthropus beds except at the entrance and at the bottom of the so-called 'lower recess'. It seems, therefore, that at the time of Sinanthropus, the cave was not accessible, but was reopened later in Upper Palæolithic times. The deposit is quite different from that of the Sinanthropus cave, being a grey loam intermixed with small angular limestone fragments. In it was discovered an unimaginable wealth of bones of fossil animals: hares, deer, tigers, bear, hyæna, ostrich and representatives of other genera.

The remains of at least seven human individuals were found with a very interesting series of archæological objects. Both fauna and geological conditions assign the finds of the Upper Cave to the Upper Palæolithic. With the exception of the finds in Palestine, no similar discovery has been made anywhere in Asia, and interest turns at once to the character of the human remains, which Prof. Franz Weidenreich considers "of the greatest importance for . . . the racial history of entire mankind".

Although seven individuals are represented, three skulls only afford evidence of physical appearance. The remainder are too fragmentary for that purpose, and the individuals, who it is presumed belonged to one family, had suffered a violent death; although the presence of hæmatite points to the ritual of burial, either the bodies were violently disturbed, or were dismembered before burial.

Analysis of the characteristics of the three skulls sufficiently complete for evidential value in this connexion leads Prof. Weidenreich to the conclusion that while the skull of the male adult, an old man more than sixty years of age, bears some resemblance to European skulls of the Upper Palæolithic Cro-Magnon, Obercassel or Mechta, it is more primitive in the development of the supra-orbital region, and the lowness of the brain-case. Of the two females, however, one in its hypsacrocranial character and certain other features presents the appearance of Melanesian affinities, while the second is Eskimoid. Viewing the characters of the male skull in the light of these findings, it is possible to regard it as a primitive Mongoloid.

The occurrence of these three types among members of a single primitive group or family suggests that the mixture of types is not a consequence of the conditions of modern civilization, but that at an early stage of evolution individual variations appear which become fixed as a result of the dominance of certain features and of isolation. Hence the conclusion is reached that the tendency to breed and cultivate unitary groups corresponding to the suggestion of the theory of 'pure races' does not represent primary conditions, but a later acquisition.

THE UPPER CAVE INDUSTRY OF CHOUKOUTIEN[2]

The cultural evidence of the existence of man of Upper Palæolithic age on this site has been studied by Mr. W. C. Pei, who discusses the objects collected, the technique of workmanship, the character of the culture, and the relationship of the Upper Cave culture with that of Europe.

Objects collected. Among stone implements the choppers are remarkable. A great number of water-worn pebbles and boulders have been found, but only a few have been worked. A good example is a green stone which has been knocked into shape with a few heavy strokes, making a blunt edge on one part of the pebble, for use as a chopper or hammer-stone. Other implements are mostly made of flint or quartz flakes. 'Bipolar' implements made of vein quartz are very similar to those associated with Sinanthropus, though geologically much later. Of bone artefacts, one bone needle, broken just at the eye, was unearthed; also a polished antler of a deer (*Cervus elaphus*), of which the surface is scratched all over and highly polished; it resembles the *bâton de commandement* but is without the perforation.

Of ornamental objects, the most important and characteristic are the beads, made of calcareous limestone, at present undetermined. One face is caused by grinding, and on the other side a hole has been made by drilling to complete the perforation; the part not reached by drilling has been struck off. The seven beads collected have all been painted red with hæmatite. They were found near one of the female skulls.

Four bone pendants were collected. They are made, apparently, of the bones of big birds, and are highly polished and hollow inside. On the surfaces of all are transverse grooves, at present not understood. A perforated pebble is of some igneous rock. It is water-rolled, but one surface seems to have been ground to a certain extent. The perforation was made by drilling from two sides. The perforated marine shells belong to a species of Area now found plentifully along the China coast. A large hole has been made near the beak of each shell by rubbing. The margin is also rubbed. The supra orbital bone of a very large fish, possibly more than three feet long, of the carp family, has a small perforation made from each side of the bone. It is a unique find on an Upper Palæolithic site, whether in China or in Europe. All these evidently were elements of a necklace. Vertebræ of fish found in association with archæological objects, though showing no trace of human handiwork, may also have been used as a necklace or ornament, as they have a natural perforation.

The most abundant and characteristic objects, however, are the canines of deer or small carnivores, with perforations. Of these, 125 have been found, among them some tens being painted red. The perforation was made by scratching from both sides, not by drilling. Often they were found in series, and obviously represent parts of necklaces or other ornament.

Working techniques. These comprise polishing, grinding, drilling, scratching, rubbing, and colouring. In reference to this last, pieces of hæmatite have been found showing traces of scratching.

Culture: (1) *Burial customs.* The Upper Cave was evidently a burial cave in which the remains were disturbed by animals. Of the mode of burial nothing is known beyond the fact that a quantity of hæmatite powder was scattered around the dead.

(2) *Communications.* Upper Palæolithic man of Choukoutien had relations over a wide area extending 150 kilometres to the north, 350 kilometres to the south and 200 kilometres to the south-east. The indications are marine shells from a sea-coast, of which the nearest point is now 200 km. to the south-east; hæmatite, large-grained and oolitic in structure, iron ore of this nature being known only in the district of Lungkuan, about 150 km. to the north, with high mountain ranges intervening; the big lincoid shell found at the present day only on the south bank of the Yellow River, 350 km. or more to the south.

(3) *Clothing.* The suggestion of the bone needle is the sewing of cloth, while perforated objects point to the passing of string for a necklace ornament. The inference is that some type of clothing with ornaments was in use.

(4) *Other elements.* Though of the daily life nothing is known, pieces of charcoal and layers of ashes full of free carbon imply the use of fire, while fish vertebræ point to the practice of fishing, though no harpoon or hook has been found. The presence of teeth of deer, fox, badger, and pendants of the bones of a big bird suggest that these animals may have been hunted.

Comparison with Europe. As there is no material in China for comparison, no chronological succession can be established. Geologically, the culture is contemporary with the Grand Loess of North China, that is, late Pleistocene, and as such comparable with the Upper Palæolithic of Europe. The technique of scratching instead of drilling in perforation is more primitive than either Magdalenian or Aurignacian; but at the same time, the technique of fashioning beads, the grinding, drilling, polishing, show that the culture could scarcely be more primitive than Magdalenian. Hence, though geologically contemporary with either of these cultures, the cultural relation remains an open question.

[1] Weidenreich, Franz, "On the Earliest Representatives of Modern Mankind recovered on the Soil of East Asia", *Peking Natural History Bull.*, **13**, 3 (1939).

[2] Pei, W. C., "On the Upper Cave Industry." *Peking Natural History Bull.*, **13**, 3 (1939).

THE VICTORIA FALLS HYDRO-ELECTRIC SCHEME

THE Victoria Falls and Transvaal Power Company has recently completed a very successful hydro-electric scheme at the Victoria Falls on the Zambezi River. About thirty years ago a proposal for supplying the Rand with power from the Victoria Falls was projected. The overhead transmission line was to be 700 miles long and the pressure 150,000 volts. Although owing to technical difficulties this project could not be realized at that time, yet the Power Company retained its right to develop the power at the Falls, so that if methods of transmission were improved and developed it might become commercially feasible at a later date. The scheme that has just been completed is the first outcome of that arrangement. It is especially interesting owing to the fact that it is completely automatic.

An article by Mr. H. L. Bazalgette giving a full description of the station is published in the October–December issue of the *English Electric Journal*, the contractors being the English Electric Co., London. The generating station is situated in the third gorge, known as the 'Silent Pool', at a hairpin bend in the river about two miles downstream from the Falls. It contains two 1,000 kilowatt, automatically controlled units, the purpose of which is to generate power for transmission over a distance of about seven miles to the town of Livingstone, until recently the capital of Northern Rhodesia, and also over a distance of about two miles to the Falls Hotel which, with the generating station itself, is in Southern Rhodesia.

In 1936 a comprehensive contract was placed with the English Electric Company for the power station and substation equipment. On March 17, 1938, the new power station was opened by the Governor of Northern Rhodesia, who by simply pressing a button started up the first unit under automatic control. In addition to the two purposes mentioned above, the plant will be able to supply any small industries arising around the town of Livingstone, which may eventually become the centre of an active industrial area.

The climatic conditions are damp and tropical and were exceptionally trying for the erecting staff, the engine room temperature rising at times to 110° F. Owing to the fact that the site is a famous beauty spot, great care was taken by the Power Company in South Africa to obviate disfigurement, and this has been done so successfully that the power station and penstock are practically hidden by vegetation from passers-by. Beyond a daily visit of inspection, the station runs automatically and is unattended. From the point of view of health the situation of the station would be unsuitable for the prolonged attendance of an operating staff.

Automatic devices are introduced which give protection from sustained over-current, over-voltage, over-speed, alternator field failure, internal faults, overheated bearings, oil failure and if it takes longer than the normal starting time. Any of these would automatically cause the unit to shut down and the main oil switch to 'trip'.

The erection and placing into service of the plant was carried out by C. G. T. Clarke, who spent fifteen months on the site. A very interesting and scientific account of the Victoria Falls, written by him, is quoted in the *Journal*. It was carried out in co-operation with the Survey Department of the Northern Rhodesia Government. Between the Main Falls and the Devil's Cataract there exists a small valley hitherto unseen by man which presents a splendid spectacle of beauty with its carpet of maidenhair fern and overhung by evergreen trees. The spray from Devil's Cataract there serves the glade as a natural water-can, and the water drops

sparkle in the brilliant sunshine which penetrates the trees. At the bottom of the Devil's Cataract the great pool is always kept in a very turbulent state by the ever-falling torrent, creating waves at least two feet high on the far side of the pool, while the spray rises far above the precipitous sides and produces brilliant rainbows by day or by night at full moon. The wedge-shaped crevice cutting into Cataract Island gives clear evidence of earthquake activity and could not have been caused by erosion of the hard basalt rock. By descending hand over hand by means of a rope attached to a tree on the crest of the Falls on the Eastern Cataract, Mr. Clarke and his assistant got to the bottom of the abyss.

They observed that at the base of the Falls chasm the strata are vertical and run parallel to the Falls, yet the 300 ft. of basalt comprising the perpendicular face of the Falls appears to be in five distinct layers in the horizontal plane, each layer being a shade different in colour. They swam across the pool beyond the base of the Eastern Cataract after convincing themselves that no crocodiles were present. They explored the entire base of the Falls for the first time and state definitely that no traces of animal remains were seen.

With the help of the chief surveyor, Mr. Younger, twelve careful readings of the height of the Falls were taken. The maximum height was found to be 355 ft., and this spot is at a place on the west side of the "Arm Chair". Devil's Cataract has a drop of 200 ft., while the Eastern Cataract is 282 ft. high.

ELECTRICALLY MANUFACTURED STEELS

A PAPER on electrically manufactured steels by H. B. Sieveking, of the Central Electricity Board, originally allocated for reading before the Institution of Electrical Engineers on November 23, has been circulated owing to the decision not to hold meetings for the time being. He first gives a description of the two principal types of electric furnaces used; the main products are next discussed from a metallurgical point of view and the advantages and disadvantages of the two types of furnaces for meeting specific requirements are reviewed.

For the manufacture of steel two types of furnace have been developed—the arc and the high-frequency induction types. The low-frequency type is rarely used nowadays. Arc furnaces are used for melting or for keeping molten metal hot. Generally they are of the vertical 3-phase 3-electrode type. The furnace comprises a refractory hearth which may be of 'basic' (for example, magnesite, MgO) or 'acid' (for example, silica SiO_2) material as required and in which the charge is placed. The necessary heat is obtained by electric arcs formed between the charge and the electrodes which project through the roof in triangular formation. In general, an acid lining is cheaper but this type of lining is 'dead', that is, it does not allow of impurities being removed from the bath. The more expensive basic lining, on the other hand, is suitable for refining. The position of the electrodes is adjusted either by hand or automatically. Hand adjustment is simple but is apt to give rise to violent fluctuations of power. Some form of automatic control, consisting of an electric motor, or a hydraulic servo motor on each electrode, is to be preferred. A special transformer is used with special tappings which allow of a voltage variation from 60 to 250 during service. The largest size in practice will usually take a charge of about 30 tons. There is one in use in America which has six arcs and will take a charge of 100 tons.

There exist to-day a very large number of alloy steels, some of which present manufacturing difficulties which can only be overcome in an electric furnace. Let us first consider the high-frequency furnace. It has very thin walls but it is possible to get through about fifty charges without relining. This corresponds to about one week's working. The advantages of this type of furnace are: the absence of oxidizing atmosphere, no carbon pick-up, suitability for intermittent operation and high temperatures are obtainable. The disadvantages are its high capital cost and limited capacity. It is known that an arc furnace load is such that with a good operating power factor the short-circuit current swings to be taken on the mains will not exceed twice full load. The swings usually occur in the first half of the melting period. In Great Britain until 1934 the proportion of electric steel was nearly constant, with two well-marked exceptions in 1918 and 1926—the last year of the War and the year of the General Strike respectively. Since 1934, which corresponds to a period first of trade depression and then of rearmament, there has been a steady increase in the proportion.

In the United States the electric steel follows very closely the total output of steel. The United States, Germany and Great Britain stand respectively first, second and third in regard to total output, but sixth, eighth and ninth in respect of proportion of electric steel produced, being above only Luxembourg and Belgium. The countries producing the greatest proportion of steel electrically are Italy and Sweden—countries rich in water power and poor in coal, and only standing seventh and eleventh in regard to total output. The world output of electric steel is about 3 per cent of the total, but if Italy and Sweden are omitted the proportion is only 2 per cent. From the tables given in the paper it is evident that in Great Britain the term electric steel must be confined at present to steels which have a high selling price. The weight of finished steel used to-day is far higher than that required in theory as engineers use a high factor of safety. With ordinary steel the material structure is not uniform and therefore the strength of the weakest point must be guessed and the steel dimensioned accordingly. An electric steel, on the other hand, has a very uniform structure and it would therefore seem possible to reduce the factor of safety at least by an amount sufficient to make the total cost of the steel requirements the same whether the steel is manufactured electrically or by one of the other methods. It is undoubtedly along these lines that some countries are working at the present time in order to reduce their internal steel consumption to a minimum.

APPOINTMENTS VACANT

APPLICATIONS are invited for the following appointments on or before the dates mentioned:

TEACHERS OF ELECTRICAL ENGINEERING—The Principal, County Mining and Technical School, Nuneaton, Warwickshire (January 3).

EXPERIMENTAL OFFICERS (male or female) in the Chemical Inspection Department, Woolwich, or at Provincial Stations in Great Britain—The Ministry of Supply (S.E.3.B), The Adelphi, W.C.2 (quoting Appts. 016/S.E.3(B) (January 4).

A MASTER FOR PHYSICS AND MATHEMATICS—P. Abson, Haberdashers' Aske's School, Chase Lodge, N.W.7.

TEMPORARY METEOROLOGICAL ASSISTANTS (male) in the Meteorological Office—The Under-Secretary of State, S.2.B.(Met.), Department Q.J., Air Ministry, Adastral House, Kingsway, W.C.2.

A PART-TIME TEACHER OF ENGINEERING DRAWING—The Director of Education, The Polytechnic, 309 Regent Street, W.1.

REPORTS AND OTHER PUBLICATIONS

(not included in the monthly Books Supplement)

Great Britain and Ireland

Proceedings of the Royal Irish Academy. Vol. 45, Section A, No. 5: On Matrices of Quaternions and the Representation of Eddington's E-Numbers. By W. H. McCrea. Pp. 65–72. Vol. 45, Section B, No. 13: Larval Stages of the Euphausiid *Thysanopoda acutifrons* (Holt and Tattersall) taken off the South-West Coast of Ireland. By Winifred E. Frost. Pp. 301–320. 1*s.* 6*d.* Vol. 45, Section B, No. 14: River Development in Southern Ireland. By A. Austin Miller. Pp. 321–354. 2*s.* Vol. 45, Section B, No. 15: The Significance of Monomolecular Layers of Fatty Acids in the Control of Animal Oxidation. By J. M. O'Connor. Pp. 355–372. 1*s.* (Dublin: Hodges, Figgis and Co., Ltd.; London: Williams and Norgate, Ltd.). [3011

Department of Scientific and Industrial Research. Methods for the Detection of Toxic Gases in Industry. Leaflet No. 11: Aniline Vapour. Pp. iv+9. (London: H.M. Stationery Office.) 3*d.* net. [3011

Charity and the Struggle for Existence. (The Huxley Memorial Lecture for 1939.) By Dr. R. R. Marett. Pp. 14. (London: Royal Anthropological Institute.) [112

University of Reading: National Institute for Research in Dairying. Annual Report for the Year ending 30th September 1938. Pp. 96. (Shinfield, Reading: National Institute for Research in Dairying.) [112

University of Cambridge: Solar Physics Observatory. Twenty-seventh Annual Report of the Director of the Solar Physics Observatory to the Solar Physics Committee, 1938 August 1–1939 July 31. Pp. 4. (Cambridge: Solar Physics Observatory.) [412

National Institute of Industrial Psychology. Annual Report and Statement of Accounts for the Year ended 30 September 1939. Pp. 24. (London: National Institute of Industrial Psychology.) [412

Philosophical Transactions of the Royal Society of London. Series A: Mathematical and Physical Sciences. No. 791, Vol. 238: The Effects of Thunderstorms and Lightning Discharges on the Earth's Electric Field. By Dr. T. W. Wormell. Pp. 249–303+plates 2–17. (London: Cambridge University Press.) 22*s.* [512

University of Sheffield. Summaries of Theses submitted by Successful Candidates for Higher Degrees, Session 1938–39. Pp. 4. (Sheffield: The University.) [612

British Museum and British Museum (Natural History). Annual Report of the General Progress of the Museums for the Year 1938. Pp. 29. (London: H.M. Stationery Office.) 6*d.* net. [712

Department of Scientific and Industrial Research. Methods for the Detection of Toxic Gases in Industry. Leaflet No. 8: Phosgene. Pp. iv+8+2 plates. 2*s.* 6*d.* net. Leaflet No. 9: Arsine. Pp. iv+6+2 plates. 2*s.* 6*d.* net. (London: H.M. Stationery Office.) [812

Other Countries

National Research Council of Japan. Report, Vol. 2, No. 8, April 1938–March 1939. Pp. iii+609–728. (Tokyo: National Research Council of Japan.) [2911

Journal of the Indian Institute of Science. Vol. 22A, Part 16: The Relation between the Iodine Values and Refractive Indices. Part 3: Hardened Safflower Oil. By R. V. Joglekar and S. K. K. Jatkar. Pp. 219–224. 10 annas. Vol. 22A, Part 17: Reactions of Chromates at High Temperatures. Part 10: Decomposition of Mixtures of Calcium Chromate with Sodium Carbonate and with Ferric Oxide. By D. S. Datar and S. K. K. Jatkar. Pp. 225–236. 1 rupee. Vol. 22A, Part 18: Researches on Utilisation of Cane Molasses. Part 5: Nitrogen Fixation by the Solid-Lime Compound in the Soil and its Bearing on Plant Growth. By T. R. Bhaskaran, S. C. Pillai and V. Subrahmanyan. Pp. 237–247. 1 rupee. (Bangalore: Indian Institute of Science.) [2911

Symposium on Molecular Spectra, held in August 1934. (Supplement to the "Proceedings of the Indian Academy of Sciences".) Pp. 129. (Bangalore: Indian Academy of Sciences.) 2 rupees; 3*s.* [2911

Wood is Good. No. 1: Veneers. By W. Nagle. (Woodworking Series.) Pp. v+7+6 plates. (Dehra Dun: Forest Research Institute.) [3011

Canada: Department of Mines and Resources, Mines and Geology Branch. Geological Survey Paper 39–4: Preliminary—The Stratigraphy and Structure of Turner Valley, Alberta. By G. S. Hume. Pp. iii+20. (Ottawa: King's Printer.) 10 cents. [3011

Astrophysica Norvegica. Vol. 3, No. 5: The Meteor Train of March 24, 1935. By Carl Størmer. Pp. 117–138+3 plates. Vol. 3, No. 6: Über die Schwingungen eines stabil geschichteten, durch Meridiane begrenzten Meeres. Von Egil A. Hylleraas. Pp. 139–164. (Oslo: Jacob Dybwad.) [3011

Svenska Linné-Sällskapets Årsskrift. Årgång 22, 1939. Pp. vi+148. (Uppsala: Almquist and Wiksells Boktryckeri A.-B.). [3011

Ministry of Agriculture, Egypt: Technical and Scientific Service. Bulletin No. 221: Water-Table Effects. 4: Relative Incidence of Diseases on Cucurbits. By Dr. Amin Fikry. Pp. ii+9+19 plates. P.T. 3. Bulletin No. 225: An Expedition to Arabia for Locust Investigations. By M. Hussein. Pp. ii+22+10 plates. P.T. 2. (Cairo: Government Press.) [3011

Report on the Administration of the Meteorological Department of the Government of India in 1938–39. Pp. iii+41+4 plates. (Delhi: Manager of Publications.) 14 annas; 1*s.* 3*d.* [112

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Ministry of Finance, Egypt: Survey and Mines Department. Contributions to the Geography of Egypt. By Dr. John Ball. Pp. xv+308+9 plates. (Cairo: Government Press.) P.T. 50; 10*s.* 6*d.* [412

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Annals of the New York Academy of Sciences. Vol. 39, Art. 3: Electrophoresis. By Harold A. Abramson, Edwin J. Cohn, Bernard D. Davis, Frank L. Horsfall, Lewis G. Longsworth, D. A. MacInnes, Hans Mueller and Kurt G. Stern. Pp. 105–212. (New York: New York Academy of Sciences.) [512

Geological Series of Field Museum of Natural History. Vol. 6, No. 25: A Specimen of *Elasmosaurus serpentinus*. By Elmer S. Riggs. Pp. 385–392. 10 cents. Vol. 6, No. 26: *Nanodelphys*, an Oligocene Didelphine. By Paul O. McGraw. Pp. 393–400. 15 cents. Vol. 7, No. 5: Radioactive Determination of Protactinium in Siliceous Terrestrial and Meteoritic Material. By Robley D. Evans, Jane L. Hastings and Walter C. Schumb. Pp. 71–78. 15 cents. (Chicago: Field Museum of Natural History.) [512

University of Illinois: Engineering Experiment Station. Bulletin Series No. 316: The Effect of Range of Stress on the Torsional Fatigue Strength of Steel. By James O. Smith. Pp. 38. 45 cents. Bulletin Series No. 317: Fatigue Tests of Connection Angles. By Wilbur M. Wilson and John V. Coombe. Pp. 24. 30 cents. Circular Series No. 39: Papers presented at the Fifth Short Course in Coal Utilization held at the University of Illinois, May 23–25, 1939. Pp. 174. 50 cents. Reprint Series No. 15: Stress, Strain and Structural Damage. By Herbert F. Moore. Pp. 24. 15 cents. (Urbana, Ill: University of Illinois.) [512

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Rubber Research Institute of Malaya. Annual Report 1938. Pp. 226. (Kuala Lumpur: Rubber Research Institute of Malaya.) 1 dollar. [712

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Proceedings of the United States National Museum. Vol. 87, No. 3074: A Revision of the Soapfishes of the Genus *Rypticus*. By Leonard P. Schultz and Earl D. Reid. Pp. 261–270. (Washington, D.C.: Government Printing Office.) [712

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Catalogues, etc.

Practical Hints on the Use and Maintenance of Platinum Laboratory Apparatus. (Publication No. 47.) Pp. 16. (London: Johnson, Matthey and Co., Ltd.)

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Department of Scientific and Industrial Research and Ministry of Transport: Road Research. Bulletin No. 3: A Printing Method of Recording Road Surface Texture. By J. S. Wilson. Roy. 8vo. Pp. vi +6 +11 plates. (London: H.M. Stationery Office, 1939.) 9*d*. net.*

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Williams, Robert S., and Homerberg, Victor O. Principles of Metallography. (International Chemical Series.) Fourth edition. Ex. Cr. 8vo. Pp. ix +339. (New York and London: McGraw-Hill Book Co., Inc., 1939.) 23*s*.*

Willis, Arthur J. More Advanced Quantity Surveying; with Many Examples and Diagrams and a Separate Portfolio of Full-Scale Plates. Med. 8vo. Pp. 289. (London: Crosby Lockwood and Son, Ltd., 1939.) 21*s*. net.

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